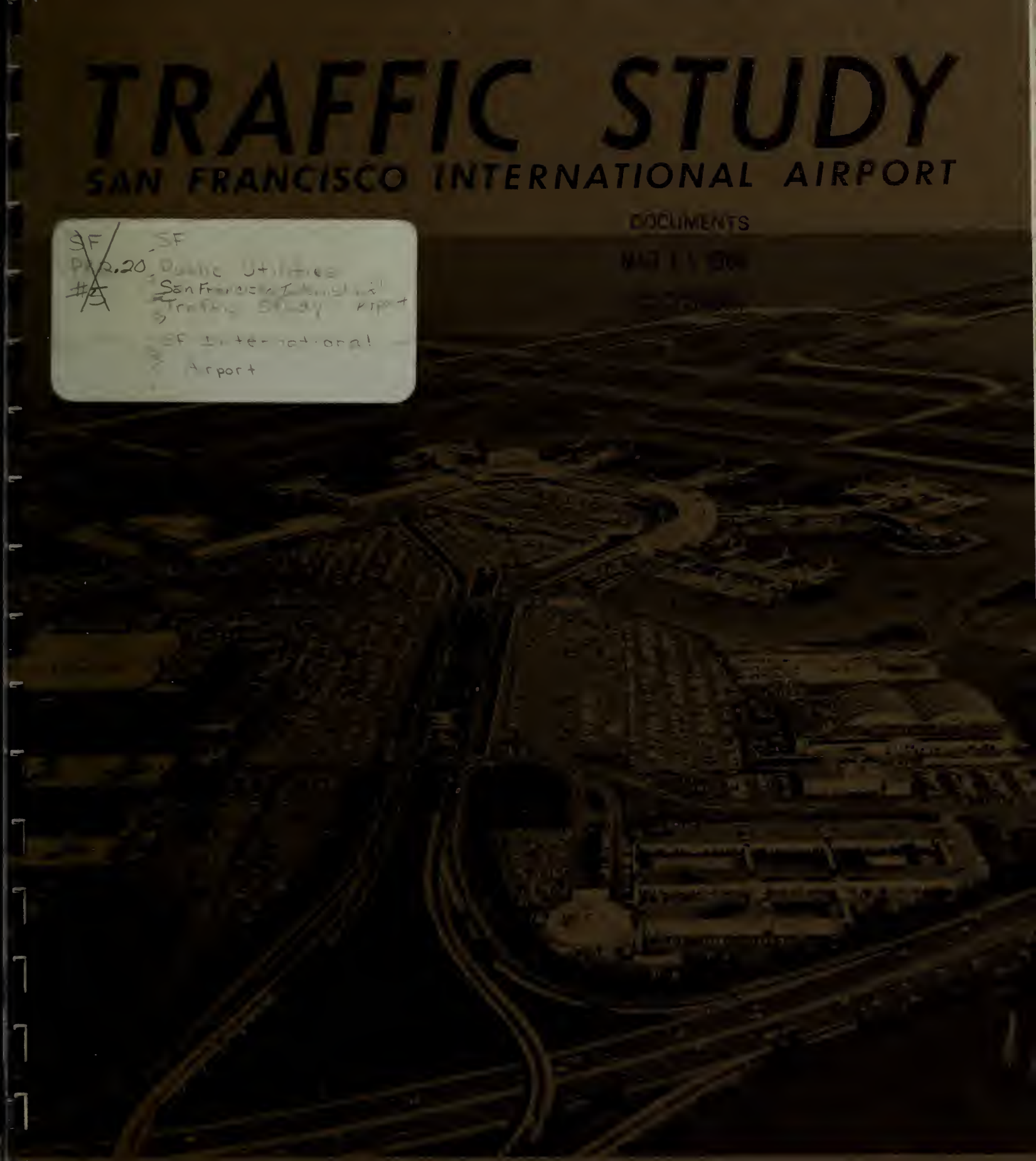
TRAFFIC STUDY

SAN FRANCISCO INTERNATIONAL AIRPORT



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TRAFFIC STUDY

TRAFFIC STUDY
SAN FRANCISCO INTERNATIONAL AIRPORT

Prepared for

PUBLIC UTILITIES COMMISSION
City and County of San Francisco

JAMES K. CARR
General Manager,
Public Utilities Commission

GEORGE F. HANSEN
Airport General Manager

DALE H. FEARN
Assistant General Manager
Planning & Development

December, 1967

Wilbur Smith & Associates

Traffic study : San Francisco International 1967.

Wilbur Smith & Associates, Inc.
CALIFORNIA

CABLE: WILSMITH

CONSULTING ENGINEERS

582 MARKET STREET
SAN FRANCISCO, CALIF. 94104
982-3221

December 21, 1967

Mr. George F. Hansen
General Manager
San Francisco International Airport
San Francisco, California

Dear Mr. Hansen:

In accordance with our contract dated August 7, 1967, we are pleased to submit herewith a report analyzing the surface transportation patterns existing at San Francisco International Airport, and estimating future ground transportation needs for the years to come.

The factual information contained in this report represents a comprehensive data base of great utility for future planning. We believe that the results will be of great interest not only to the Airport staff but to the airport architects, airport tenants, local agencies, regional highway and transit planners, and many others associated with the air industry in the San Francisco Bay Area and other parts of the country.

It has been a pleasure to work with you on this very interesting and significant project, and we appreciate the assistance rendered to our Project Engineer, Mr. Paul Bay, by yourself, Mr. Dale Fearn and others of your staff.

Very truly yours,

Frederick C. Pearson

Frederick C. Pearson
Principal Associate

Registered Professional Engineer
California No. 15613

PNB/dt

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INTRODUCTION

Objectives of Study

One of the most perplexing problems of the air age is the disparity between airport-airport travel speeds in a modern jetliner, and the often frustratingly-slow trip from the airport to destination. As air travel has grown in the post-war years, the press of people and cars converging upon the terminals in ever greater numbers has heightened that disparity to a point of near-crisis. The impending onset of even further technological advances in aircraft — notably the "Jumbos," carrying up to 500 passengers, and the supersonic transports, traveling at even greater speeds — has made the improvement of ground transportation imperative.

San Francisco International Airport, as the fourth busiest airport in the United States, has received more than its proportional share of the ground problems perplexing airports everywhere, and in spite of almost continuous building of new parking lots and passenger facilities has only been able to just hold its own from year to year. The recent passage (November, 1967) of a bond issue by the San Francisco voters now makes monies available for some construction of facilities for the future.

In order to plan these future facilities, the San Francisco Public Utilities Commission retained Wilbur Smith and Associates to make a complete analysis of the size, parameters, and characteristics of the ground transportation problems at San Francisco International Airport, and from that base, to estimate future needs.

The contract called for analysis of passenger, employee, commercial vehicle and rental car parking, as well as public transit parking and loading; and for similar analysis of access and circulation requirements of each mode and for each segment of airport activity.

The major study objective has been to get a clear understanding of the present character of surface transportation at San Francisco International Airport, and to present design directions for the future facilities that will be needed.

Acknowledgments

In the course of this study, assistance has been rendered by many persons, including personnel of all of the airlines serving San Francisco International Airport, the Federal Aviation Agency, other airport tenants and employers, the Airport Parking Garage operator, the San Mateo County Engineer's Office, the California Division of Highways, the West Bay Rapid Transit District, the Bay Area Transportation Study Commission, Barrett Transportation Company, Greyhound Bus Company, Yellow Cab Company, and a number of motels and hotels in the area. Census Tract Data was provided by the Santa Clara County Planning Commission, San Mateo County, and the San Francisco Planning Department. The Airport Police and others from the airport staff provided assistance during the survey phase of the work.

The comments of Professor Robert Horonjeff of the Institute of Transportation and Traffic Engineering of the University of California, and the unfailing courtesy and assistance of Mr. Dale Fearn, Assistant General Manager for Planning and Development, were especially appreciated.

The following references were consulted in the course of the study, and some are referred to in this report, where pertinent data is cited:

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Chapter II

INVENTORY OF EXISTING TRAFFIC FACILITIES

External Access

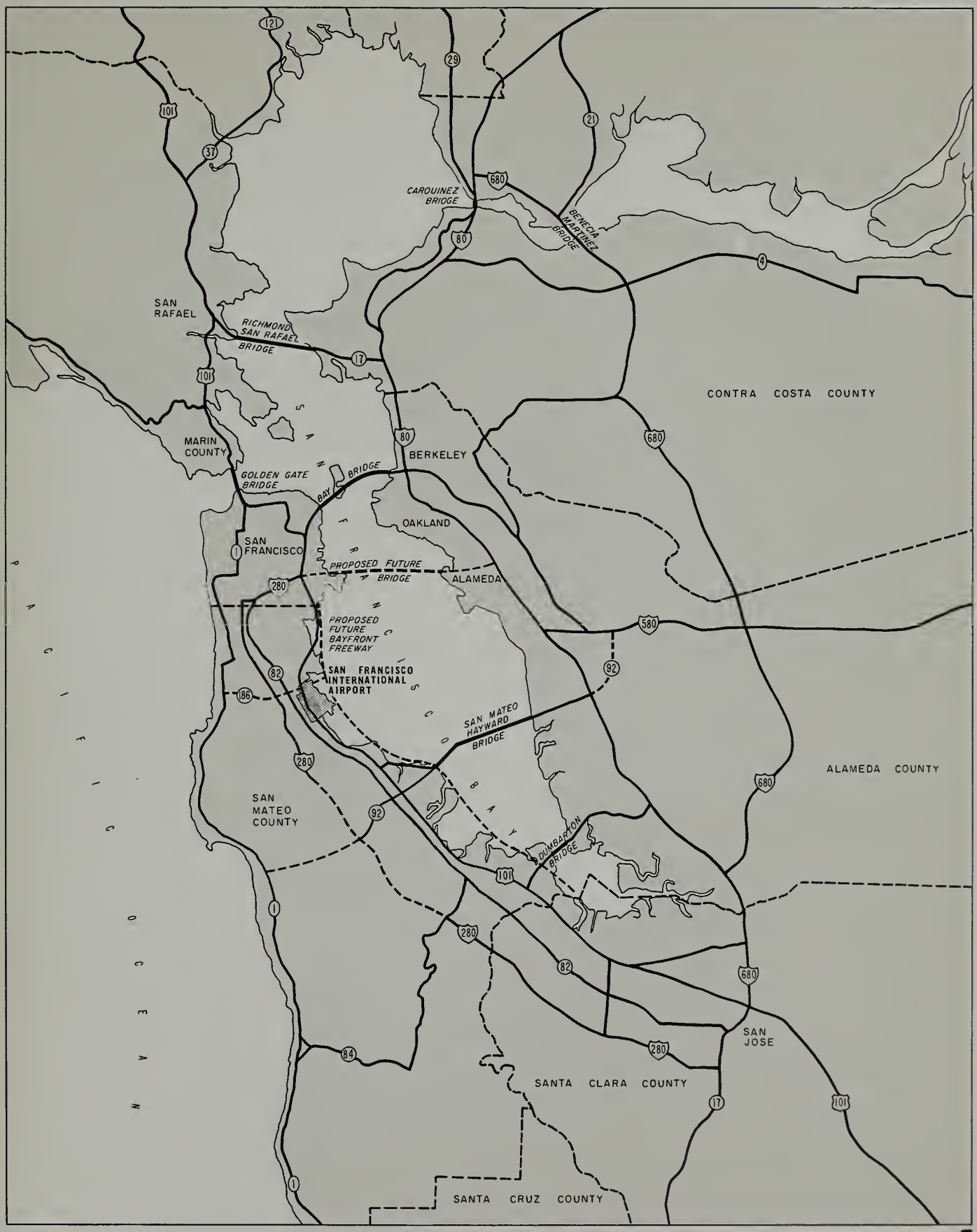
San Francisco International Airport, located on the San Francisco Peninsula adjacent to the Bay and ten miles south of San Francisco (see Figure 1) is presently served only by Bayshore Freeway (U.S. 101). Unless one arrives by air, one cannot now approach the airport without using Bayshore Freeway or one of its interchanges.

At present, Bayshore Freeway serves the airport quite adequately in off-peak hours, with good connections to downtown San Francisco, most Peninsula communities, and the three bridges leading to East Bay communities.

However, as the major artery on the growing San Francisco Peninsula, Bayshore Freeway has long since reached capacity during peak hours, resulting in fewer and fewer hours of congestion-free flow. During these long peak periods, the congestion causes serious delay to airport travelers.

Adjacent to the airport, Bayshore Freeway now has four lanes in each direction, with three lanes each way north of the airport to San Francisco. The California Division of Highways is planning to widen the latter portion to four lanes each way in the Spring of 1968.

A second major north-south freeway to serve the Peninsula is now under construction in segments. Junipero Serra Freeway (Interstate Route 280 on Figure 1) has been completed as an eight-lane divided freeway between San Francisco and Millbrae, and between San Jose and Palo Alto. The sections from Palo Alto to Millbrae will be completed by 1972, under present plans. When the two completed end sections are tied together, some slowing in growth of traffic on Bayshore Freeway will almost certainly occur, as Peninsula commuters split the long-distance trips between Bayshore and Junipero Serra Freeways.



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LOCATION MAP AND HIGHWAY ACCESS

Wilbur Smith & Associates

SAN FRANCISCO INTERNATIONAL AIRPORT TRAFFIC STUDY

Three Bayshore Freeway interchanges now serve the airport, (shown on Figure 2) and another two provide indirect access to the airport via Airport Boulevard.

The three interchanges are at Millbrae Avenue (a modified partial cloverleaf), at San Bruno Avenue (a full cloverleaf), and at the main entrance-exit road to the airport terminal buildings (direct connections on two separate one-lane structures and two one-lane diagonal ramps). The two indirect access interchanges are at Broadway Avenue in Burlingame, and Airport Boulevard in South San Francisco. Both of these interchanges are of old, substandard design and would have serious congestion problems even without any airport users.

East-west travel from the airport vicinity is extremely difficult at present. Millbrae Avenue provides reasonably good access west to El Camino Real, but not very good service beyond. San Bruno Avenue is presently the major east-west link, with four lanes of traffic open to El Camino Real and Junipero Serra Freeway and two lanes to Skyline Boulevard.

A new major east-west artery of freeway standard, is now being designed by the California Division of Highways, with construction scheduled for 1970 to 1972. Known as San Bruno Freeway, or Route 186 Freeway, it will be built just north of the present San Bruno Avenue location, with interchanges at Skyline Boulevard, Junipero Serra Freeway, El Camino Real, and Bayshore Freeway, extending in the first stage of construction to an at-grade intersection with Airport Boulevard just north of the United Air Lines Maintenance Base.

In addition ,the San Mateo County Highway plan now calls for construction of a Canal Street Expressway in South San Francisco, to provide better connections west from the large industrial employment areas of South San Francisco, thus relieving the San Bruno Avenue interchange. No time schedule is set for that project.

In the distant future, there is a possibility of a third major north-south freeway to serve the San Francisco Peninsula being constructed east of the airport, in the bay. While it appears that this proposed "Bayfront Freeway" would provide an important addition to the highway network, and would be quite important to the airport's access needs, it is a subject of great controversy among conservationists, city planners and area business firms, and there is no assurance of its construction. Further, the possibility of such a freeway interfering with future airport and runway extensions is very real and needs thorough investigation.

Internal Circulation System

San Francisco International Airport now has three components to its internal circulation system:

The first and most heavily-used component is the divided multiple-lane highway providing direct connections between Bayshore Freeway and the Terminal Buildings and Parking Garage.

The second component is the north-south roadway parallel and adjacent to Bayshore Freeway, and known variously as the frontage road, Bayshore Service Road, Airport Access Road, and Airport Boulevard. This road, while continuous from south of the Burlingame Avenue interchange, across the entire airport lands, and north into South San Francisco Industrial Park, is plagued with poor intersections, inadequate design of curves and pavement, and congested connections at all the interchanges. Its intersection with the main airport entrance road to the terminal is grossly inadequate in design and capacity.

The third component of the airport's internal circulation system is the system of roadways coming from Airport Boulevard to parking lots and buildings. It includes the North Access Road, which runs from Airport Boulevard north of the United Maintenance Base to the Coast Guard Station and Seaplane Harbor; a roadway serving the United States Post Office Air

Mail Facility and the hangars near it; and the two roadways parallel to the main airport entrance roadways, which serve employee parking lots, hangars, air cargo buildings, and the service areas near the terminal buildings.

At present, a large part of the airport lands lie west of Bayshore Freeway, and have no access to the rest of the airport or to local city streets, hence are unused.

The internal circulation system as a whole now works quite inefficiently during the peak hours, with serious congestion and delays to employees, service vehicles and air passengers alike. Further, the traffic burden is not shared equally among the facilities, and parts of the system are sometimes overloaded while other parts are not near capacity. Intersections and interchanges are the critical areas, and along with the curbs and roadways directly in front of the terminal buildings effectively control the capacity of airport movements.

Parking

Parking lots are actually part of the circulation system, but such an important part that they are discussed separately here. In design, however, it is essential that they be treated integrally with the circulation system.

At San Francisco International Airport, parking is provided for at least six distinct types of users:

1. Air passengers, parking for periods of one to six days while traveling.
2. Air passengers and those greeting or serving air passengers, who seek parking for a limited time — less than twelve hours, usually less than two hours.
3. Employees working at the airport, who park in periods of six to twelve hours, generally in regular shifts.

4. Buses, taxicabs, limousines and private cars seeking parking at the curbs nearest the terminal buildings for periods of minutes only to load or discharge passengers and baggage.
5. Rental cars, parked usually in small numbers near the terminal buildings for quick use by customers, and in larger reservoirs further away.
6. Trucks and service vehicles providing goods and services to the terminal buildings, aircraft, maintenance hangars, cargo buildings, fuel dumps, etc.

(In addition, 400 spaces at the Hilton Inn are for hotel patrons.)

Figure 2 shows the present parking areas available at the Airport, and Table 1 summarizes the parking spaces by type.

Employee parking needs in most areas are growing faster than the supply of spaces, and employees are now walking greater and greater distances to their place of employment from their parking space, as a result.

Figure 2 shows that the area with the second largest grouping of employees, the terminal buildings area, actually contains few parking spaces and no employee spaces. The demand for parking spaces near the terminal buildings is, of course, shared not only by employees, but by air passengers and those serving them, the majority of airport visitors on business, the buses, taxicabs and limousines, a sizable share of the trucks, and the rental cars.

Terminal Building Interface

As the focus of the heaviest demands by all airport users, the terminal buildings complex represents a key part of the circulation system.

San Francisco International Airport now has two terminal buildings located on a circular traffic loop fed directly to and from Bayshore Freeway

LEGEND

PARKING LOTS

DAILY NUMBER OF EMPLOYEES AT AIRPORT (600)

PARKING AREA BOUNDARY

N O R T H

2

0 1000 2000 3000 4000

SCALE IN FEET

NUMBER OF EMPLOYEES AT AIRPORT BY AREAS ON WEEKDAY , 1967

Wilbur Smith & Associates

SAN FRANCISCO INTERNATIONAL AIRPORT TRAFFIC STUDY

Table 1
PARKING IN USE AT SAN FRANCISCO INTERNATIONAL AIRPORT, JULY, 1967
San Francisco International Airport Traffic Study

PUBLIC PARKING		
Airport Garage	-	2,700 spaces
Parking Lot No. 1	-	500 spaces
Parking Lot No. 2	-	1,800 spaces
Valet Parking	-	1,100 spaces
TOTAL		6,100 spaces
EMPLOYEE PARKING		
Near Pan Am Hangar	-	870 spaces
Near TWA Hangar	-	350 spaces
Near United Hangars	-	900 spaces
Large North Lot (general)	-	700 spaces
Large South Lot (general)	-	240 spaces
Near Present Cargo Buildings	-	600 spaces
Near Pacific Hangar	-	150 spaces
Near Post Office Facility	-	200 spaces
Near American Hangar	-	150 spaces
Near United Maintenance Base	-	3,000 spaces
Near Coast Guard Station	-	100 spaces (÷500 not in use)
TOTAL		7,170 spaces
RENTAL CAR STORAGE	-	300 spaces
OFFICIAL CARS AND OTHER		
(Large Lots West of Bank of America)	-	230 spaces
GRAND TOTAL		13,800 spaces

(In addition, 400 spaces for Hilton Inn patrons and employees, approximately 200 truck loading docks, and 3,600 feet of curb space at terminal building for turnover parking, exist at the Airport.)

via the main airport entrance roadways, which are continuous with the loop. One more terminal building will be constructed on this loop, so that the three buildings are spaced at 90° from one another, with the fourth quadrant occupied by the main entrance roadway stem.

In the center of this circle is a four-level parking garage, with direct pedestrian connections via speed-ramps and escalators to the terminal buildings, through underground tunnels. The traffic loop in front of the buildings is actually two concentric loops on two levels, with the upper loop serving flight departures, and the lower loop flight arrivals.

The spaces between terminal buildings, called "courtyards" are used for storage of rental cars, but in peak rental hours, additional cars must be trucked or "jockeyed" in to serve customer demand.

The curb space along the terminal building loop roadways is used for valet parking stops on the interior (garage) side, and for 30-minute time-limit parking meters between buildings on the terminal side. The remainder of space right in front of the buildings, is shared by taxicabs, hotel limousines, Airport (Barrett) Buses, Greyhound Buses, charter buses, military transports and private autos, all trying to get as close to the point of passenger and luggage pickup or dropoff as possible. In peak hours, this competition for inadequate curb space prevents free flow of vehicles around the loop, and reflects its congestive effect back onto the main entrance roadway, and sometimes onto Bayshore Freeway.

The problem is complicated by the difficulty of handling luggage from airplane to car, or vice-versa. As a result, drivers will often drop off passengers and luggage first, at the curb, then circle back around the loop and make a U-turn on the main entrance roadway to enter the garage to park. A similar situation exists in reverse for de-planing passengers. This doubling

up of congestion by using both curb space and garage, plus extraneous circling and turns on the loop and entrance roadways is highly undesirable.

Chapter III
TRAFFIC DATA

Airport Employment

In order to verify traffic survey results, questionnaires were sent to each of the more than 100 airport tenants (see Table 3), asking for July, 1967, employment levels, separated by work shift, category of employee, and airport employment location.

Questionnaires were accompanied by a letter from the Airport Manager, asking that the completion of the forms be supervised by responsible management personnel to insure accuracy. This was especially important in the case of one of the questions, which asked for a forecast of each firm's expected employment level at San Francisco International Airport in July, 1971.

All but five small tenants provided the data requested, which is shown in Figure 2, and Tables 2 and 3.

The results show about 23,000 persons employed at San Francisco International Airport in July, 1967, with about 21,000 working in a given 24-hour weekday period. This total divides up in to about 9,000 maintenance employees, 6,000 administrative-clerical, and 4,000 flying personnel, plus 2,000 service, retail and miscellaneous.

As expected, day shift totals are highest, with 10,000 employees, followed by swing shift with 4,300 and graveyard with 2,400 employees. A surprisingly large number of employees — 3,700 — work irregular or odd shifts, reflecting the large number of flying personnel who leave the airport at other than normal shiftends.

The question of who <u>is</u> employed at the airport can never be given an exact answer because of the large number of hazy areas. For example, is a stewardess who flies in once a week and has a one-day layover employed at

Table 2
EMPLOYEES AT AIRPORT[a] (ALL THREE SHIFTS)
ON A WEEKDAY, JULY, 1967
San Francisco International Airport Traffic Study

CATEGORY	NO. OF EMPLOYEES	
AIRLINE EMPLOYEES[a]		
Flight Crews[b]	3,800	
Aircraft Maintenance or aircraft ground service	8,500	
Administrative, clerical or passenger services	5,100	
		17,400
ALL OTHER EMPLOYEES		
Part-time or irregular shift	350	
Maintenance personnel	375	
Clerical, administrative, etc.	925	
Retail shops, restaurants, hotel, etc.	1,050	
Other	275	
		2,975
TOTAL		20,375
Graveyard shift	2,350	
Day shift	10,000	
Swing shift	4,300	
Odd shifts	3,725	
AVERAGE DAY EMPLOYMENT, 1967[a]	20,375	
TOTAL EMPLOYMENT, 1967[a]	23,000	
ESTIMATED TOTAL EMPLOYMENT, 1971[a]	36,500	

(a) Based on questionnaire survey of all tenants of San Francisco International Airport in July, 1967.
(b) Flight crew figures show estimated daily number of flight crews personnel actually staying overnight or leaving the airport while in transit, whether living in San Francisco area or not.

Table 3
AIRPORT TENANTS, 1967
San Francisco International Airport Traffic Study

AIRLINES

Air California
American
BOAC
Canadian Pacific
Delta
Flying Tiger Lines
Japan Air Lines
Lufthansa
National
Pacific
PSA
Pan American Airlines
Phillipine
Qantas
SFO Helicopter
TWA
United
West Coast
Western

OTHER TENANTS

Air Express Companies
Air Forwarders
Commercial Aviation Companies
Oil Companies
Aircraft Services
Inflight Food Caterers

GOVERNMENT AGENCIES

Airport Management (San Francisco P.U.C.)
San Mateo County Sheriff Substation
U.S. Coast Guard
U.S. Customs Bureau
U.S. Department of Agriculture
U.S. Federal Aviation Agency
U.S. Immigration and Naturalization Service
U.S. Military Information Desk
U.S. Post Office
U.S. Public Health Service
U.S. Weather Bureau

PUBLIC SERVICES

U.S.O. Lounge
Traveler's Aid Society
Airport Animal Shelter

RETAIL AND COMMERCIAL SERVICES

Barber Shops
Beauty Salons
Newsstands and Smokeshops
Gift Shops
Banks
Bookstore
Drugs and Sundries
Restaurants, Bars, Snack Counters
Flower Shops
Reading Rooms
Candy Stores
Wine Shops
Shoe-Shine Stands
Automotive Service Stations
Parking Garages
Rental Car Lots
Skycap Porter Services
Airport Bus
Hotel
Taxicab Stands

San Francisco International Airport? Or the bus-driver or taxicab driver? Or the telephone repairman who spends 75 percent of his time at the airport? For the purposes of this study, we were less interested in the total number of employees than in the total number of persons entering, parking, and leaving the airport at a given hour and day who were there for the purpose of employment.

Therefore, flying personnel totals show the number of persons in flight crews who leave the airport by ground transportation on an average day. Some of them live in the Bay Area, and others are only laying over for a few hours or a day. The total does not include all the persons who ever fly into San Francisco; conversely, it does not necessarily include all flight crew members who live in the area and work out of San Francisco International Airport — only the number who are here on an average day.

This helps to account for the difference between the 21,000 employees our totals show and the 23,000 to 25,000 employees estimated to "work at the airport."

The questionnaire response indicated that San Francisco International Airport tenants' management expects about 35,000 employees at San Francisco International Airport in 1971. Even allowing a reduction for the kind of thing mentioned in the preceding paragraph, this indicates about a 50 percent increase within four years, and poses great space problems to the Airport Manager.

Air Passenger and Air Cargo Flows

To further check validity of traffic survey data, and to provide a base parameter for future comparisons, all the airline tenants of San Francisco International Airport were requested to provide hour-by-hour totals of air cargo movements and arriving air-passenger movements. These totals are summarized in Tables 4 and 5.

3

N O R T H

0 1000 2000 3000 4000

SCALE IN FEET

24 HOUR TRAFFIC VOLUMES
SUMMER , 1967

Wilbur Smith & Associates

SAN FRANCISCO INTERNATIONAL AIRPORT TRAFFIC STUDY

Table 4
TOTAL HOURLY CARGO MOVEMENTS OF ALL AIRLINES
San Francisco International Airport Traffic Study

HOUR	TUESDAY NIGHT, JULY 18, 1967 WEDNESDAY NIGHT, JULY 19, 1967			SATURDAY NIGHT, JULY 22, 1967 SUNDAY NIGHT, JULY 23, 1967		
	INBOUND[(a)] CARGO	OUTBOUND CARGO	TOTAL DAILY CARGO	INBOUND CARGO	OUTBOUND CARGO	TOTAL DAILY CARGO
10 P.M.-11 P.M.	85,083	176,959	262,042	82,343	134,691	217,034
11 P.M.-12 Mid.	13,851	1,747	15,598	9,934	157,143	167,077
12 Mid. -1 A.M.	0	35,646	35,646	1,021	85,494	86,516
1 A.M. - 2 A.M.	11,423	436	11,859	562,747	10,117	572,865
2 - 3	64,871	19,801	84,672	9,666	77,446	87,112
3 - 4	1,005	3,400	4,405	3,400	0	3,400
4 - 5	51,081	68,744	119,825	18,120	0	18,120
5 - 6	55,494	2,629	58,123	69,754	0	69,754
6 - 7	178,424	4,748	183,172	98,872	55,989	154,861
7 - 8	38,429	88,015	126,444	1,033	31,485	32,518
8 - 9	56,868	108,906	165,774	53,949	33,403	87,352
9 - 10	4,669	65,481	70,150	2,545	28,749	31,294
10 - 11	39,264	23,352	62,616	30,956	26,711	57,668
11 - 12 Noon	68,611	30,817	99,429	29,217	22,793	52,010
12 Noon - 1 P.M.	81,603	154,144	235,748	11,007	18,714	29,721
1 - 2 P.M.	38,628	25,365	63,993	75,461	7,790	83,251
2 - 3	50,899	10,476	61,375	4,086	6,414	10,500
3 - 4	25,096	5,962	31,058	20,416	7,792	28,208
4 - 5	23,053	83,594	106,647	23,298	14,256	37,554
5 - 6	49,646	27,417	77,063	16,185	53,671	69,856
6 - 7	75,497	74,225	149,722	58,177	44,156	102,333
7 - 8	99,267	120,551	219,818	30,343	81,585	111,928
8 - 9	3,947	24,620	28,567	27,261	2,992	30,253
9 - 10	54,299	267,385	321,685	67,583	91,366	158,949
TOTAL	1,171,013	1,424,424	2,595,438	1,307,378	992,761	2,300,139

(a) All cargo in pounds.

Table 5
TOTAL HOURLY OUTBOUND PASSENGER FLOW OF ALL AIRLINES[a]
San Francisco International Airport Traffic Study

HOUR	TUESDAY NIGHT, JULY 18, 1967 WEDNESDAY NIGHT, JULY 19, 1967 TOTAL OUTBOUND FLIGHTS	TOTAL EMPLANING PASSENGERS	SATURDAY NIGHT, JULY 22, 1967 SUNDAY NIGHT, JULY 23, 1967 TOTAL OUTBOUND FLIGHTS	TOTAL EMPLANING PASSENGERS
10 P.M. - 11 P.M.	17	795	13	971
11 P.M. - 12 Mid.	1	64	3	116
12 Mid. - 1 A.M.	8	416	7	452
1 A.M. - 2 A.M.	1	90	2	71
2 - 3	1	11	2	85
3 - 4	1	65	0	0
4 - 5	1	17	0	0
5 - 6	1	27	0	0
6 - 7	5	96	3	22
7 - 8	27	936	22	1,265
8 - 9	25	1,177	22	1,258
9 - 10	20	1,213	20	1,567
10 - 11	21	1,314	24	1,652
11 - 12 Noon	14	1,182	13	886
12 Noon - 1 P.M.	19	1,163	20	1,228
1 P.M. - 2 P.M.	18	1,221	18	1,129
2 - 3	14	944	15	643
3 - 4	15	747	15	877
4 - 5	20	1,085	18	710
5 - 6	20	1,026	18	1,099
6 - 7	16	989	18	1,071
7 - 8	16	496	15	831
8 - 9	20	444	19	1,040
9 - 10	14	516	15	1,015
TOTAL	315	16,007	302	17,988

(a) TWA not included — information not provided.

While these totals have no direct application to the ground transportation data they are extremely important in evaluating the relationship of ground movements and aircraft movements, and as such are discussed in detail in the chapter on Future Projections.

Vehicle Volumes

On the traffic survey week, July 13 to 21, 1967, traffic counts were taken on all aiport roads and on the ramps of the Bayshore Freeway interchanges serving the airport. These traffic counts are summarized in the appendix, Table A-2, and the average daily traffic totals are shown on Figure 2.

In addition, hand traffic counts were taken at the intersection of the main airport entrance road, and the airport frontage road, to evaluate turning movements and to determine classifications of vehicles — i.e., percentages of trucks, buses, and cars.

Volume-Capacity Analyses

At the intersections of Airport Boulevard (Airport service road or frontage road) with the main entrance road, Millbrae Avenue, and San Bruno Avenue; and along the main entrance road loop contiguous to the terminal buildings, special study was made to determine present traffic volumes and present capacities. These results are summarized in Table 6.

It is immediately apparent from the available data that three of the four locations now have serious capacity problems, and in fact, observation at the other location, Millbrae Avenue, has shown that it is also in trouble because of the heavy peak-hour movements from and to the Burlingame Airport Industrial Park, though it does not now show in the data.

The intersections of San Bruno Avenue and the Main Entrance Road with Airport Boulevard were studied in detail to determine how their capacities might be increased to meet future demands, considering turning movements

Table 6
TRAFFIC VOLUMES AND CAPACITIES AT KEY LOCATIONS
San Francisco International Airport Traffic Study

INTERSECTION OF THE
MAIN ENTRANCE ROAD
AND AIRPORT FRONTAGE ROAD — PEAK HOUR CONDITIONS

APPROACH	JULY, 1967[a] PEAK HOUR VOLUME	NUMBER OF LANES	PRESENT CAPACITY (NON-CONGESTED FLOW)
Inbound	2,240	3	3,000
Outbound	2,330	2	2,000
Northbound	743	1	600
Southbound	1,255	1	600

INTERSECTION OF THE
AIRPORT FRONTAGE ROAD
AND MILLBRAE AVENUE — PEAK HOUR CONDITIONS

APPROACH	JULY, 1967[a] PEAK HOUR VOLUME	NUMBER OF LANES	PRESENT CAPACITY (NON CONGESTED FLOW)
Southbound	500	1	600
Northbound	Not Known	2	2,000
Eastbound	Not Known	2	1,200

INTERSECTION OF
AIRPORT BOULEVARD
AND SAN BRUNO AVENUE — PEAK HOUR CONDITIONS

APPROACH	JULY, 1967[a] PEAK HOUR VOLUME	NUMBER OF LANES	PRESENT CAPACITY (NON-CONGESTED FLOW)
Eastbound	2,400	2	1,800
Northbound	1,152	2	1,200
Southbound	1,376	2	1,200

ROADWAYS NEAR
TERMINAL BUILDINGS — PEAK HOUR CONDITIONS

NUMBER OF LANES	JULY, 1967 PEAK HOUR VOLUME	PRESENT CAPACITY (NON-CONGESTED FLOW)
2	Est. 2,000	1,500

CURB SPACES USAGE AT
CENTRAL TERMINAL, LOWER LEVEL — 7-8 P.M. WEEKDAY

TYPE USE	NO.VEH. PER HOUR	AVG.TIME/VEH. AT CURB(Mins.)	NO.MIN. CURB USED	NO.SPACES REQ./HOUR	FT. OF CURB REQ.
Airport Bus	20	5	100	2	120 Ft.
Charter Bus	10	15	150	3	180 Ft.
Yellow Cab	125	3	375	7	210 Ft.
Hotel Limo.	25	4	100	2	60 Ft.
Private Auto	400	3	1,200	20	600 Ft.
					1,170 Ft.

(a) Intersection also carries large volumes of pedestrians.

and pedestrians as well as increase volumes, and the recommendations for each location are given later in this report.

The Terminal Building roadway problem is also given further special attention, because it represents the key problem in future capacity of the airport terminal complex.

Rental Car Movements

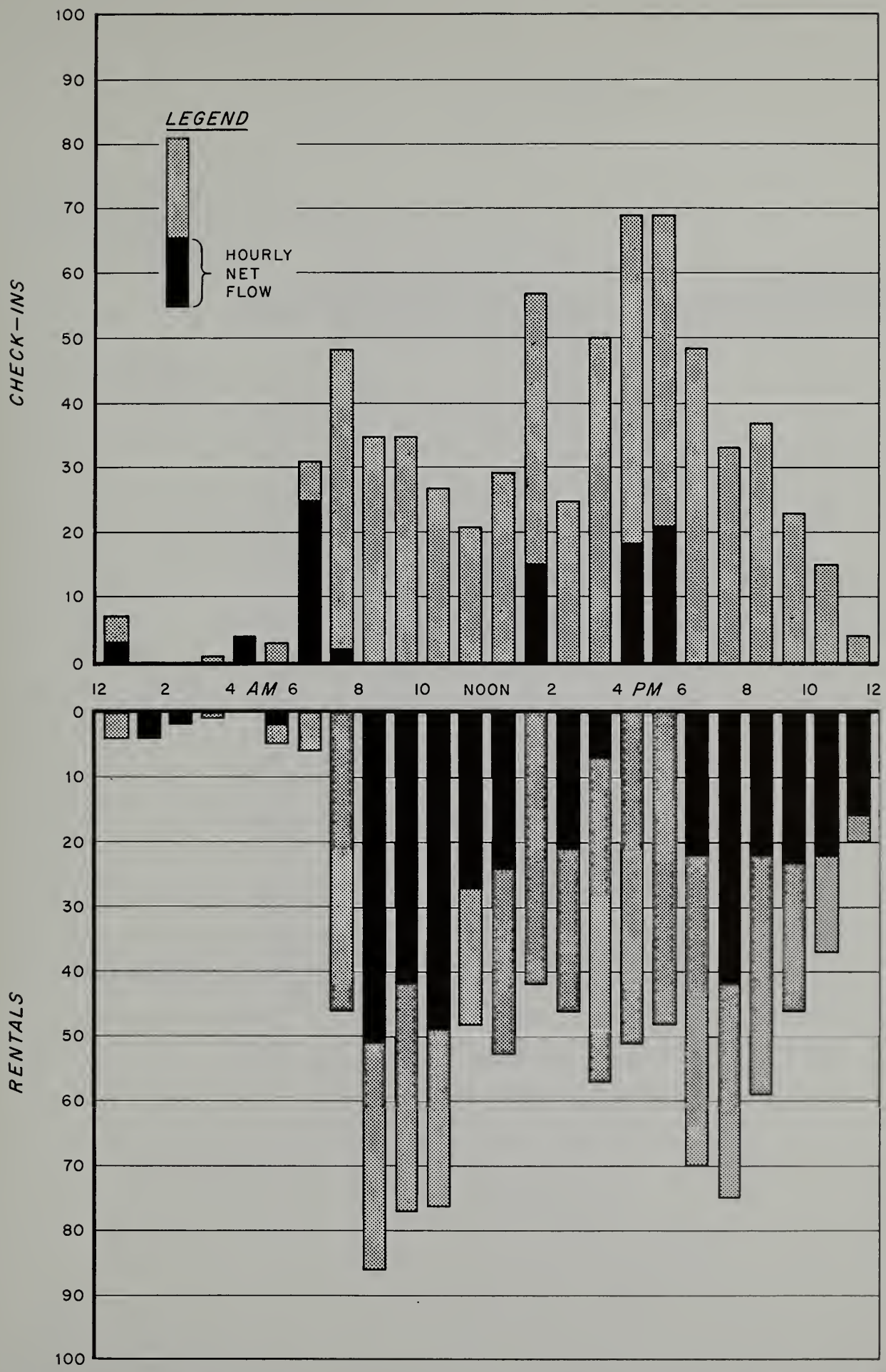
The three major auto rental firms having space at San Francisco International Airport were contacted and asked to supply hour-by-hour flow information for rental car movements on the two survey days, to provide checks against the traffic survey data. This information is shown in Table 7.

In addition to the inflow and outflow, the actual number of rental cars maintained at the airport was checked hour-by-hour, and the maximum accumulation determined.

Each of the rental car firms at San Francisco airport attempts to keep at least 100 cars in storage available for rental at all times. In order to do this, additional cars must be trucked in during the hours of heavy rental.

These accumulation figures are shown for two of the firms on Figure 4.

It became apparent from the survey that rental car flows do not have a daily tidal rhythm, but a weekly one. That is, in order to truly evaluate the rental car space requirements, a tabulation similar to Table 7 and Figure 4 should be made for an entire week. It appears that Sunday night to Wednesday are heavy rental periods, and Thursday night to Saturday are heavy check-in periods.



HOURLY NET FLOW OF RENTAL VEHICLES
WEDNESDAY JULY, 1967 (HERTZ, AVIS, AND NATIONAL RENT-A-CAR)

Table 7
RENTAL CAR FLOWS[(a)], JULY, 1967
San Francisco International Airport Traffic Study

TIME	WEDNESDAY			SUNDAY		
	RENTALS -	CHECK-INS +	NET FLOW	RENTALS -	CHECK-INS +	NET FLOW
12 Mid. - 1 A.M.	4	7	+ 3	5	4	- 1
1 A.M. - 2 A.M.	4	0	- 4	0	0	0
2 - 3	2	0	- 2	1	1	0
3 - 4	1	1	0	4	0	- 4
4 - 5	0	4	+ 4	2	0	- 2
5 - 6	5	3	- 2	2	1	- 1
6 - 7	6	31	+ 25	9	3	- 6
7 - 8	46	48	+ 2	10	39	+ 29
8 - 9	86	35	- 51	25	55	+ 30
9 - 10	77	35	- 42	35	43	+ 8
10 - 11	76	27	- 49	35	25	- 10
11 - 12 Noon	48	21	- 27	45	18	- 27
12 Noon - 1 P.M.	53	29	- 24	36	16	- 20
1 P.M. - 2 P.M.	42	57	+ 15	27	30	+ 3
2 - 3	46	25	- 21	52	29	- 23
3 - 4	57	50	- 7	35	32	- 3
4 - 5	51	69	+ 18	42	38	- 4
5 - 6	48	69	+ 21	34	29	- 5
6 - 7	70	48	- 22	59	15	- 44
7 - 8	75	33	- 42	48	29	- 19
8 - 9	59	37	- 22	54	26	- 28
9 - 10	46	23	- 23	61	19	- 42
10 - 11	37	15	- 22	60	9	- 51
11 - 12 Midnight	20	4	- 16	46	9	- 37
TOTAL	959	671	- 288	727	470	- 257

(a) Hertz, Avis and National Rent-A-Car are included; car rental companies not using airport space are not included.

| | | |

Parking Garage Usage

Survey personnel, on the two survey days, made checks on the usage of the large employee lots, to determine accumulation of vehicles at the airport. Since the employee lots had relatively little change during working hours, one check during each shift was deemed adequate.

It was found that 750 of all available employee spaces were in use during the day shift on the weekday survey, and that the most desirable spaces (nearest work locations) were more than 100 percent used. The major problem is providing simultaneous parking for workers from two shifts during the late afternoon shift overlap period, and during this time many of the 25 percent undesirable unused spaces fill. This problem is especially acute for United Air Line Maintenance Base employees.

However, the public parking garage was a different situation altogether, with constant inflow and outflow. Various ways of checking hour-by-hour totals in the public parking facilities were considered, but since none of these methods could be effected on the two survey days, only random checks were made, and the figures compared with the complete counts done the previous summer as a research project by the Institute of Traffic and Transportation Engineering at the University of California. These figures are shown in Table 8.

The highest accumulation of vehicles in the public facilities occurs during late afternoon, though a high percentage of available spaces are occupied between 8:00 A.M. and 10:00 P.M.

Table 8
PUBLIC GARAGE PARKING FLOWS [a] AND
ACCUMULATIONS ON AVERAGE WEEKDAY
San Francisco International Airport Traffic Study

HOUR	CARS ENTERING	CARS EXITING	ACCUMULATION OF PARKED CARS
12 Mid. - 1 A.M.	65	150	2,319
1 A.M. - 2 A.M.	28	74	2,273
2 - 3	16	42	2,247
3 - 4	11	28	2,230
4 - 5	16	7	2,239
5 - 6	58	6	2,291
6 - 7	347	45	2,593
7 - 8	675	131	3,137
8 - 9	524	323	3,338
9 - 10	455	380	3,413
10 - 11	377	386	3,404
11 - 12 Noon	475	330	3,549
12 Noon - 1 P.M.	435	290	3,594
1 P.M. - 2 P.M.	393	406	3,681
2 - 3	382	395	3,668
3 - 4	390	390	3,668
4 - 5	356	424	3,600
5 - 6	413	400	3,613
6 - 7	481	515	3,579
7 - 8	518	603	3,494
8 - 9	382	715	3,161
9 - 10	367	407	3,121
10 - 11	261	491	2,891
11 - 12 Mid.	133	313	2,711
TOTAL	7,558	7,251	

(a) From Research Report No. 44, "Vehicular Traffic Patterns at an Airport In Relation to Airline Passenger Volumes," Dimitrios Koussios and Wolfgang S. Homburger, ITTE, University of California.

AGE	EXPOSED	OCCUPATIONAL DISEASES
1		279
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20 - 21		
22 - 23		
TOTAL		

Chapter IV

THE TRANSPORTATION SURVEY

Survey Procedures

The basic questions for this study were: Who travels to and from the airport? How do they travel? Where do they go when they leave? Why are they at the airport? What times of day are they at the airport? If driving, where do they park?

To obtain answers to these questions, a survey was designed that would effectively screen every person leaving the airport in a 24-hour period on each of two survey days — Wednesday, July 19, and Sunday, July 23, 1967.

Cordon vehicle survey stations were established at each of four points of possible exit from the airport: Main Entrance-Exit Road; Airport Service Road at Millbrae Avenue; Airport Service Road at San Bruno Avenue, and North Access Road at Airport Boulevard.

The only other vehicular exits from the airport possible are via San Bruno Avenue and North Airport Boulevard. These two routes include much non-airport traffic, and the only airport traffic they include that can not be caught at one of the other survey station locations is traffic from the United Air Lines Maintenance Base. For this reason, it was decided to not establish survey stations at these last two exit locations, but to provide a special questionnaire to all United Air Lines Maintenance Base employees on the survey days, and get the same information in that manner.

At each of the four cordon stations, survey personnel were provided with return post card questionnaires and instructed to stop cars on a random basis and ask them to complete and return the questionnaires.

Traffic counts were made hour-by-hour at each station, to provide data on the percentage of total vehicles that were given a reply card. The cards themselves were pre-numbered, and control records were kept to determine the ratio of cards distributed each hour at each station to cards completed and returned.

Trucks and autos received different questionnaires.

In addition to the vehicle surveys, questionnaires were also distributed to each passenger boarding an outbound airport bus (Barrett Bus Company), and San Francisco-Oakland helicopter. Boarding Greyhound Bus patrons were queried by interviewers stationed at the bus stops. Taxicab and hotel limousine drivers were also supplied with questionnaires for their passengers, and requested to ask their passengers to complete and return them.

Management of each of these transportation companies also were asked to provide us with hour-by-hour totals of riders, to determine percentage of response. This data was provided only in part by the hotel limousine and taxicab companies.

The survey questionnaires themselves, designed for quick completion and easy coding and key punching, included questions on travel mode, trip purpose, airport trip-end location, destinations after leaving airport, vehicle occupancy, luggage, time of day, length of stay at airport, and parking location.

Survey Response and Sensitivity

On each of the two survey days, approximately 18,000 vehicle questionnaires, and 6,000 bus, helicopter, and taxi questionnaires were distributed. On Wednesday, 8,000 employee questionnaires were distributed to United Maintenance Base employees.

The return varied from almost 100 percent of the Barrett Bus passengers and United employees, through nearly 30 percent of the automobile drivers, to less than 10 percent of the taxicab passengers. As the largest single group, the automobile drivers' response was most important to the survey as a whole.

The hour-by-hour percentage return did not vary significantly for auto drivers except in the peak hour, when the percentage of total autos returning the cards was lower. However, this apparently only reflected the fact that the percentage of drivers receiving a card to return was lower in the peak hours to prevent congestion. (Survey personnel had been instructed to reduce the sample when long queues were forming.) The ratio of cards returned to cards distributed did not have any observable relationship to the hour of the day.

The very large sample size and the relatively high percentage of returns for most segments of the survey makes possible a good deal of confidence in the sensitivity of the survey data. No biases were found in checking such things as time or spatial distribution.

Further, checks of the survey data internally were quite consistent. When all modes were summed and the returns factored to the known control level (for example, the return auto cards were expanded each hour to the known total auto count) the number of person trips indicating "employment" as the purpose for being at the airport was very close to the known total employment. Other checks, such as on parking garage usage and rental car usage were accurate within 10 percent.

The one area that caused concern was the paucity of taxicab and hotel limousine data. For this reason, those figures were deleted from the computer run, and were manually distributed and added in later, after consultation with each of the hotels giving limousine service to the airport, and with the Yellow Cab Company dispatcher. When any question remained about the validity of

Table 9
PERSON TRIPS DEPARTING FROM AIRPORT BY SURFACE TRANSPORTATION — DEPARTURE MODE VERSUS PURPOSE OF AIRPORT VISIT
San Francisco International Airport Traffic Study

DEPARTURE MODE	NUMBER OF PERSON TRIPS BY TRIP PURPOSE								
	AIR PASS.	SERVE PASS.	BUSINESS	SOCIAL	FLT. CREW	OTHER AIRLINE EMPLOYEES	ALL OTHER EMPLOYEES	ALL OTHER PURPOSES	TOTAL
WEEKDAY									
Auto[(a)]	15,487	18,403	2,599	971	2,295	12,416	3,239	2,286	57,696
Taxicab	1,710	22	25	40	0	0	0	0	1,797
Hotel Limousine	700	0	0	0	300	0	0	25	1,025
Helicopter	449	0	0	0	5	2	0	0	456
Barrett Bus	2,610	133	20	50	112	72	14	32	3,043
Other Bus	449	18	4	9	10	1,050	36	28	1,604
Truck	0	0	0	0	0	0	0	1,185	1,185
All Other Modes	0	0	0	0	0	96	0	0	96
TOTAL	21,405	18,576	2,648	1,070	2,722	13,636	3,289	3,556	66,902 Person Trips
SUNDAY									
Auto[(b)]	18,355	29,612	1,486	1,900	1,218	4,445	970	1,853	59,839
Taxicab	1,840	23	0	138	0	0	0	0	2,001
Hotel Limousine	944	0	0	0	0	0	94	0	1,038
Helicopter	408	0	0	4	7	5	0	7	431
Barrett Bus	2,515	75	48	56	102	352	31	44	3,223
Other Bus	0	0	0	0	0	0	0	0	0
Truck	0	0	0	0	0	0	0	221	221
All Other Modes	0	0	0	0	0	0	0	0	0
TOTAL	24,062	29,710	1,534	2,098	1,327	4,802	1,095	2,125	66,753 Person Trips

(a) Average car occupancy on weekday = 1.94
(b) Average car occupancy on Sunday = 2.61

Table 10

PERSON TRIPS TO 45 ZONES OF DESTINATION AFTER LEAVING AIRPORT, CLASSIFIED BY PURPOSE OF AIRPORT VISIT, ON A WEEKDAY, 1967

San Francisco International Airport Traffic Study

ZONE NO.	COUNTY	DESCRIPTION OF AREA ZONE INCLUDES	NUMBER OF PERSON TRIPS						
			AIR PASS.	SERVE PASS.	BUS. & SOC.	FLT. CREW	ALL OTHER EMPLOYEES	OTHER PURPOSE	TOTAL
01	San Francisco	San Francisco Central Business District	4,257	1,303	507	126	490	340	7,023
02	San Francisco	San Francisco North-Central Area	1,728	1,221	238	277	772	211	4,447
03	San Francisco	San Francisco Southeastern Quadrant	509	795	131	4	537	194	2,170
04	San Francisco	San Francisco - From the Presidio to Golden Gate Park	503	326	15	21	269	26	1,160
05	San Francisco	San Francisco Southwestern Quadrant	730	772	93	8	437	81	2,121
06	San Mateo	Daly City, Colma	190	345	93	8	469	46	1,151
07	San Mateo	Brisbane	19	17	10	0	111	14	171
08	San Mateo	South San Francisco Industrial Area	333	365	261	9	840	467	2,275
09	San Mateo	San Bruno, San Francisco International Airport	631	486	158	28	1,476	310	3,089
10	San Mateo	Pacifica	86	236	52	29	424	25	852
11	San Mateo	Central Coastside Area (not including Half Moon Bay)	0	12	5	2	100	9	128
12	San Mateo	Millbrae	643	504	240	42	661	229	2,319
13	San Mateo	Burlingame	839	547	350	185	1,131	255	3,307
14	San Mateo	Hillsborough	122	172	83	12	49	23	461
15	San Mateo	Foster City, San Mateo	1,003	1,116	331	689	2,408	283	5,830
16	San Mateo	San Mateo Highlands, Belmont Hills, San Carlos Hills	353	582	61	85	684	31	1,796
17	San Mateo	Half Moon Bay	0	7	0	0	68	0	75
18	San Mateo	Eastern Belmont and San Carlos	215	229	115	55	638	43	1,295
19	San Mateo	Eastern Redwood City, East Palo Alto, Eastern Menlo Park	130	73	15	10	233	24	485
20	San Mateo	Western Redwood City, Western Menlo Park	626	595	45	104	955	74	2,399
21	San Mateo	Woodside, Portola Valley, West Slope of Coast Range	218	184	11	43	95	6	557
22	San Mateo	South Coastside	11	4	9	0	19	0	43
23	Santa Clara	Northern Bayside Area (Palo Alto to Alviso)	852	793	117	82	490	79	2,413
24	Santa Clara	Western Foothills (Stanford University to Monte Bello)	664	925	59	157	305	75	2,185
25	Santa Clara	W. Sunnyvale, So. West San Jose, Cupertino, Campbell, Saratoga, Los Gatos	725	943	66	188	612	57	2,591
26	Santa Clara	Agnew, Santa Clara, No. West San Jose, San Jose Airport	301	391	14	26	285	35	1,052
27	Santa Clara	San Jose Central Business District, Central and Southern San Jose	387	331	46	77	214	57	1,112
28	Santa Clara	Milpitas, East San Jose, Eastern Foothills	99	159	10	38	216	12	534
29	Santa Clara	South Santa Clara County - Gilroy, Morgan Hill	131	128	0	15	21	3	298
30	Alameda	Berkeley, Albany, Emeryville	372	298	12	0	56	43	781
31	Alameda	Oakland, Alameda, Altamont, Piedmont	1,095	620	41	27	293	87	2,163
32	Alameda	San Leandro, San Lorenzo, Castro Valley	209	234	65	6	135	30	679
33	Alameda	Alvarado, Decoto, Hayward, Russell, Mount Eden, Union City	189	315	37	20	435	63	1,059
34	Alameda	Centerville, Fremont, Irvington, Niles, Newark, Warm Springs, Sunol, Springtown	192	264	7	41	589	59	1,152
35	Alameda	Dublin, Livermore, Midway, Pleasanton, Mission San Jose	134	119	7	11	44	17	332
36	Contra Costa	Entire County	975	1,110	30	79	180	59	2,433
37	Marin	Entire County	744	717	103	118	113	66	1,861
38	Santa Cruz	Entire County	140	136	0	17	13	30	336
39	Sonoma	Entire County	138	214	6	6	15	0	379
40	Napa	Entire County	59	37	4	6	6	10	122
41	Solano	Entire County	534	320	96	7	26	13	996
42	San Joaquin	Entire County	72	80	0	0	0	1	153
43	-	All other counties to North	52	31	31	11	3	0	128
44	-	All other counties to East	134	132	8	0	6	16	296
45	-	All other counties to South	201	365	70	3	1	27	667
	TOTAL		21,545	18,553	3,652	2,672	16,924	3,530	66,876

Table 11

PERSON TRIPS TO 45 ZONES OF DESTINATION AFTER LEAVING AIRPORT, CLASSIFIED BY PURPOSE OF AIRPORT VISIT, ON A SUNDAY, 1967

San Francisco International Airport Traffic Study

ZONE NO.	COUNTY	DESCRIPTION OF AREA ZONE INCLUDES	APPROX. TRIP LENGTH (miles)	NUMBER OF PERSON TRIPS: AIR PASS.	SERVE PASS.	BUS. & SOC.	FLT. CREWS	ALL OTHER EMPLOYEES	ALL OTHER PURPOSES	TOTAL[a]
01	San Francisco	San Francisco Central Business District	14	3,689	1,273	475	76	342	143	5,998
02	San Francisco	San Francisco North-Central Area	15	2,083	2,159	250	154	495	97	5,238
03	San Francisco	San Francisco Southeastern Quadrant	9	560	689	62	5	197	58	1,571
04	San Francisco	San Francisco - From the Presidio to Golden Gate Park	16	587	907	82	25	69	37	1,707
05	San Francisco	San Francisco Southwestern Quadrant	10	950	1,525	184	7	195	90	2,951
06	San Mateo	Daly City, Colma	8	213	438	44	17	121	87	920
07	San Mateo	Brisbane	6	23	66	22	0	37	0	148
08	San Mateo	South San Francisco Industrial Area	4	237	364	118	5	220	85	1,029
09	San Mateo	San Bruno, San Francisco International Airport	2	650	631	304	22	397	224	2,228
10	San Mateo	Pacifica	7	151	209	65	3	194	8	630
11	San Mateo	Central Coastside Area (not including Half Moon Bay)	10	5	5	14	0	41	0	65
12	San Mateo	Millbrae	2	530	494	107	16	168	38	1,353
13	San Mateo	Burlingame	3	617	644	184	192	275	102	2,014
14	San Mateo	Hillsborough	6	187	250	0	32	2	61	532
15	San Mateo	Foster City, San Mateo	8	846	1,333	235	446	816	201	3,877
16	San Mateo	San Mateo Highlands, Belmont Hills, San Carlos Hills	11	328	712	46	55	230	99	1,470
17	San Mateo	Half Moon Bay	14	20	44	0	7	14	0	85
18	San Mateo	Eastern Belmont and San Carlos	10	317	472	60	18	256	58	1,181
19	San Mateo	Eastern Redwood City, East Palo Alto, Eastern Menlo Park	16	136	98	13	4	84	3	338
20	San Mateo	Western Redwood City, Western Menlo Park	18	790	1,027	170	27	290	115	2,419
21	San Mateo	Woodside, Portola Valley, West Slope of Coast Range	19	281	488	2	9	66	23	869
22	San Mateo	South Coastside	30	4	24	0	0	0	0	28
23	Santa Clara	Northern Bayside Area (Palo Alto to Alviso)	26	1,156	1,811	160	61	162	35	3,385
24	Santa Clara	Western Foothills (Stanford University to Monte Bello)	29	1,237	1,609	137	93	81	42	3,199
25	Santa Clara	W. Sunnyvale, So. West San Jose, Cupertino, Campbell, Saratoga, Los Gatos	36	912	1,707	124	110	171	29	3,053
26	Santa Clara	Agnew, Santa Clara, No. West San Jose, San Jose Airport	34	352	408	85	29	153	36	1,063
27	Santa Clara	San Jose Central Business District, Central and Southern San Jose	45	398	707	22	8	47	37	1,219
28	Santa Clara	Milpitas, East San Jose, Eastern Foothills	45	152	266	33	5	110	0	566
29	Santa Clara	South Santa Clara County - Gilroy, Morgan Hill	55	72	119	0	11	5	6	213
30	Alameda	Berkeley, Albany, Emeryville	23	707	819	18	0	5	16	1,565
31	Alameda	Oakland, Alameda, Altamont, Piedmont	27	1,197	1,410	104	46	55	53	2,865
32	Alameda	San Leandro, San Lorenzo, Castro Valley	23	172	383	32	0	32	13	632
33	Alameda	Alvarado, Decoto, Hayward, Russell, Mount Eden, Union City	20	289	412	98	14	122	3	938
34	Alameda	Centerville, Fremont, Irvington, Niles, Newark, Warm Springs, Sunol, Springtown	27	187	344	32	26	189	17	795
35	Alameda	Dublin, Livermore, Midway, Pleasanton, Mission San Jose	44	135	249	22	0	29	27	462
36	Contra Costa	Entire County	42	1,190	1,861	152	38	59	43	3,343
37	Marin	Entire County	30	989	1,443	43	106	68	128	2,777
38	Santa Cruz	Entire County	41	74	111	18	2	0	17	222
39	Sonoma	Entire County	53	328	452	25	11	0	9	825
40	Napa	Entire County	54	108	84	0	9	0	5	206
41	Solano	Entire County	60	236	476	5	13	5	35	770
42	San Joaquin	Entire County	-	92	190	0	0	0	21	303
43	-	All other counties to North	-	95	115	3	0	0	16	229
44	-	All other counties to East	-	187	274	55	3	0	3	522
45	-	All other counties to South	-	308	612	26	3	0	3	952
	TOTAL			23,777	29,714	3,631	1,708	5,802	2,123	66,755

	AIR PASSENGER	ALL EMPLOYEES	ALL OTHERS
Average Trip Length	21.2	14.6	18.9
Median Trip Length	15	10	14

(a) Approximately 600 person trips by Greyhound Bus not included in this table because of insufficient data.

Table 12
PERSON TRIPS TO 45 ZONES OF DESTINATION AFTER LEAVING AIRPORT, CLASSIFIED BY MODE OF DEPARTURE, ON A WEEKDAY, 1967
San Francisco International Airport Traffic Study

ZONE NO.	COUNTY	DESCRIPTION OF AREA ZONE INCLUDES	NUMBER PERSON TRIPS BY MODE OF TRANSPORTATION					
			AUTO	BARRETT BUS	TAXI & HOTEL LIMO.	HELIO.	ALL OTHER MODES	TOTAL
01	San Francisco	San Francisco Central Business District	4,001	2,214	629	0	180	7,024
02	San Francisco	San Francisco North-Central Area	3,713	449	195	5	83	4,445
03	San Francisco	San Francisco Southeastern Quadrant	2,027	33	0	0	111	2,171
04	San Francisco	San Francisco - From the Presidio to Golden Gate Park	916	129	108	0	7	1,160
05	San Francisco	San Francisco Southwestern Quadrant	1,889	49	152	0	31	2,121
06	San Mateo	Daly City, Colma	1,140	2	0	0	10	1,152
07	San Mateo	Brisbane	163	0	0	0	8	171
08	San Mateo	South San Francisco Industrial Area	1,978	16	0	0	281	2,275
09	San Mateo	San Bruno, San Francisco International Airport	2,621	15	294	0	160	3,090
10	San Mateo	Pacifica	851	0	0	0	1	852
11	San Mateo	Central Coastside Area (not including Half Moon Bay)	129	0	0	0	0	129
12	San Mateo	Millbrae	1,945	0	294	0	80	2,319
13	San Mateo	Burlingame	2,814	0	358	0	135	3,307
14	San Mateo	Hillsborough	449	0	0	0	12	461
15	San Mateo	Foster City, San Mateo	5,381	1	315	0	133	5,830
16	San Mateo	San Mateo Highlands, Belmont Hills, San Carlos Hills	1,777	0	0	0	19	1,796
17	San Mateo	Half Moon Bay	75	0	0	0	0	75
18	San Mateo	Eastern Belmont and San Carlos	1,258	0	0	0	37	1,295
19	San Mateo	Eastern Redwood City, East Palo Alto, Eastern Menlo Park	460	0	0	5	20	485
20	San Mateo	Western Redwood City, Western Menlo Park	2,350	0	0	0	49	2,399
21	San Mateo	Woodside, Portola Valley, West Slope of Coast Range	554	0	0	0	2	556
22	San Mateo	South Coastside	43	0	0	0	0	43
23	Santa Clara	Northern Bayside Area (Palo Alto to Alviso)	2,228	5	0	33	147	2,413
24	Santa Clara	Western Foothills (Stanford University to Monte Bello)	2,094	9	0	44	37	2,184
25	Santa Clara	W. Sunnyvale, So. West San Jose, Cupertino, Campbell, Saratoga, Los Gatos	2,375	2	0	5	208	2,590
26	Santa Clara	Agnew, Santa Clara, No. West San Jose, San Jose Airport	937	0	0	38	76	1,051
27	Santa Clara	San Jose Central Business District, Central and Southern San Jose	991	5	0	44	72	1,112
28	Santa Clara	Milpitas, East San Jose, Eastern Foothills	467	0	0	0	67	534
29	Santa Clara	South Santa Clara County - Gilroy, Morgan Hill	285	0	0	0	13	298
30	Alameda	Berkeley, Albany, Emeryville	711	13	0	44	14	782
31	Alameda	Oakland, Alameda, Altamont, Piedmont	1,520	38	455	115	37	2,165
32	Alameda	San Leandro, San Lorenzo, Castro Valley	588	0	0	38	53	679
33	Alameda	Alvarado, Decoto, Hayward, Russell, Mount Eden, Union City	925	0	0	5	127	1,057
34	Alameda	Centerville, Fremont, Irvington, Niles, Newark, Warm Springs, Sunol, Springtown	908	0	0	0	244	1,152
35	Alameda	Dublin, Livermore, Midway, Pleasanton, Mission San Jose	328	0	0	0	3	331
36	Contra Costa	Entire County	2,359	4	0	55	18	2,436
37	Marin	Entire County	1,790	27	0	22	22	1,861
38	Santa Cruz	Entire County	305	0	0	0	32	337
39	Sonoma	Entire County	368	5	0	0	6	379
40	Napa	Entire County	113	0	0	0	8	121
41	Solano	Entire County	706	7	0	2	281	996
42	San Joaquin	Entire County	148	2	0	0	2	152
43	-	All other counties to North	116	7	0	0	5	128
44	-	All other counties to East	254	7	0	0	34	295
45	-	All other counties to South	645	4	0	0	20	669
	TOTAL		57,695	3,043	2,800	455	2,885	66,878

Table 13

PERSON TRIPS TO 45 ZONES OF DESTINATION AFTER LEAVING AIRPORT, CLASSIFIED BY MODE OF DEPARTURE, ON A SUNDAY, 1967

San Francisco International Airport Traffic Study

ZONE NO.	COUNTY	DESCRIPTION OF AREA ZONE INCLUDES	NUMBER PERSON TRIPS BY MODE OF TRANSPORTATION					
			AUTO	BARRETT BUS	TAXI & HOTEL LIMO.	HELIO.	ALL OTHER MODES[a]	TOTAL
01	San Francisco	San Francisco Central Business District	2,835	2,212	905	7	39	5,998
02	San Francisco	San Francisco North-Central Area	4,477	419	340	0	3	5,239
03	San Francisco	San Francisco Southeastern Quadrant	1,448	28	90	0	6	1,572
04	San Francisco	San Francisco - From the Presidio to Golden Gate Park	1,566	141	0	0	0	1,707
05	San Francisco	San Francisco Southwestern Quadrant	2,786	47	115	0	3	2,951
06	San Mateo	Daly City, Colma	920	0	0	0	0	920
07	San Mateo	Brisbane	148	0	0	0	0	148
08	San Mateo	South San Francisco Industrial Area	953	2	45	0	29	1,029
09	San Mateo	San Bruno, San Francisco International Airport	1,830	0	377	0	21	2,228
10	San Mateo	Pacifica	629	0	0	0	0	629
11	San Mateo	Central Coastside Area (not including Half Moon Bay)	63	2	0	0	0	65
12	San Mateo	Millbrae	1,087	0	262	0	4	1,353
13	San Mateo	Burlingame	1,713	6	288	0	7	2,014
14	San Mateo	Hillsborough	530	0	0	0	0	530
15	San Mateo	Foster City, San Mateo	3,579	0	288	0	10	3,877
16	San Mateo	San Mateo Highlands, Belmont Hills, San Carlos Hills	1,469	0	0	0	0	1,469
17	San Mateo	Half Moon Bay	84	0	0	0	0	84
18	San Mateo	Eastern Belmont and San Carlos	1,143	4	25	0	10	1,182
19	San Mateo	Eastern Redwood City, East Palo Alto, Eastern Menlo Park	313	2	25	0	0	340
20	San Mateo	Western Redwood City, Western Menlo Park	2,353	8	45	0	12	2,418
21	San Mateo	Woodside, Portola Valley, West Slope of Coast Range	859	8	0	0	2	869
22	San Mateo	South Coastside	29	0	0	0	0	29
23	Santa Clara	Northern Bayside Area (Palo Alto to Alviso)	3,290	40	25	18	11	3,384
24	Santa Clara	Western Foothills (Stanford University to Monte Bello)	3,134	17	25	21	2	3,199
25	Santa Clara	W. Sunnyvale, So. West San Jose, Cupertino, Campbell, Saratoga, Los Gatos	3,047	4	0	4	0	3,055
26	Santa Clara	Agnew, Santa Clara, No. West San Jose, San Jose Airport	1,041	8	0	11	3	1,063
27	Santa Clara	San Jose Central Business District, Central and Southern San Jose	1,207	0	0	11	0	1,218
28	Santa Clara	Milpitas, East San Jose, Eastern Foothills	564	2	0	0	0	566
29	Santa Clara	South Santa Clara County - Gilroy, Morgan Hill	213	0	0	0	0	213
30	Alameda	Berkeley, Albany, Emeryville	1,453	15	25	72	0	1,565
31	Alameda	Oakland, Alameda, Altamont, Piedmont	2,416	198	160	64	27	2,865
32	Alameda	San Leandro, San Lorenzo, Castro Valley	629	0	0	0	3	632
33	Alameda	Alvarado, Decoto, Hayward, Russell, Mount Eden, Union City	934	0	0	4	0	938
34	Alameda	Centerville, Fremont, Irvington, Niles, Newark, Warm Springs, Sunol, Springtown	792	0	0	0	3	795
35	Alameda	Dublin, Livermore, Midway, Pleasanton, Mission San Jose	460	0	0	4	0	464
36	Contra Costa	Entire County	3,257	4	0	75	6	3,342
37	Marin	Entire County	2,647	13	0	116	0	2,776
38	Santa Cruz	Entire County	205	2	0	4	11	222
39	Sonoma	Entire County	801	8	0	7	9	825
40	Napa	Entire County	192	0	0	14	0	206
41	Solano	Entire County	759	12	0	0	0	771
42	San Joaquin	Entire County	301	2	0	0	0	303
43	-	All other counties to North	227	2	0	0	0	229
44	-	All other counties to East	505	17	0	0	0	522
45	-	All other counties to South	948	2	0	0	3	953
	TOTAL		59,836	3,225	3,040	432	224	66,757

(a) Estimated 600 person trips by Greyhound Bus not included - no data.

these data, they were not included in the totals, and that information is so noted in the tables of this report.

A summary of survey response is included in Table A-4, in the appendix. As a whole, an estimate of survey sensitivity of 80 percent is quite conservative, and a high degree of confidence can be maintained in the survey results.

Transportation Modes and Trip Purposes

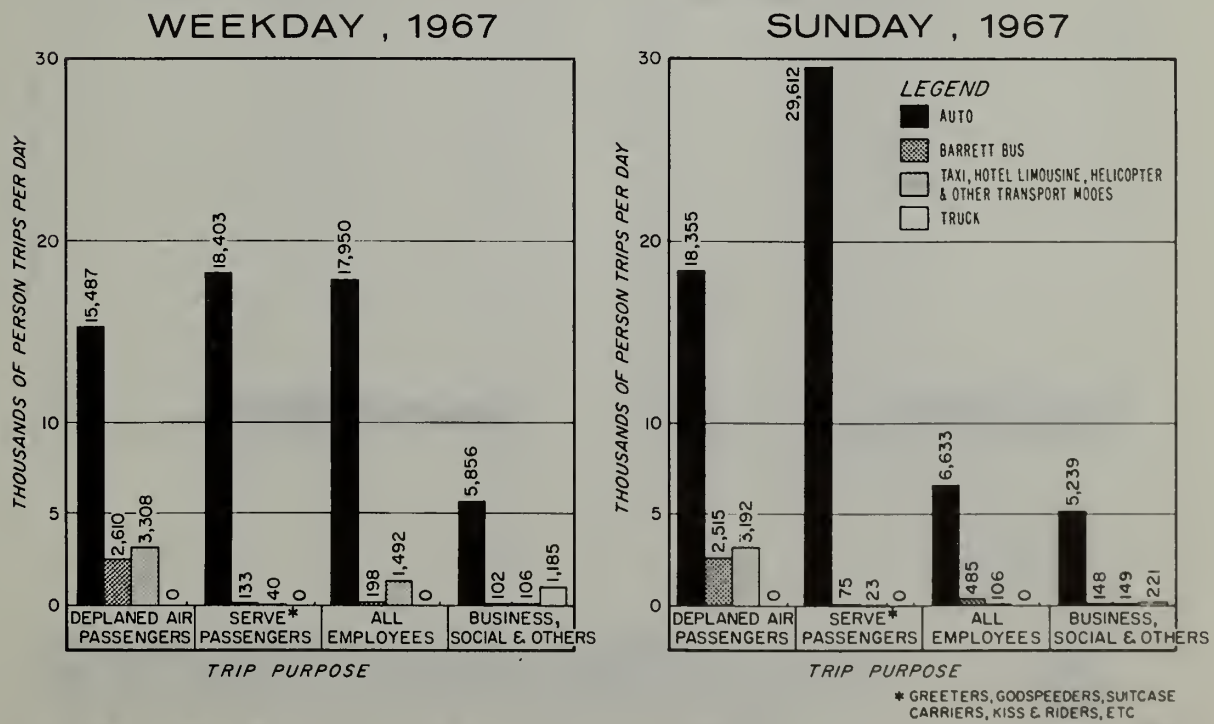
One of the key questions in this study has been "How do people travel to and from the airport?", and the answer has not been known with any precision until now. This information is summarized in Tables 9, 10, 11,12 and 13, and Figures 5, 6, 7, 8 and 9.

It is apparent from the tables that the private automobile absolutely dominates as a mode of ground transportation from the airport. The only zone of destination which has a significant number of trips to it by public transport is San Francisco's downtown area, reflecting the influence of the Barrett Bus trips to the downtown terminal, located in the heart of the hotel district.

The dominance of the automobile as the preferred mode holds for every trip purpose, also. Table 9 and Figure 5 indicate that only air passengers and airport employees use other modes to any appreciable degree, and even they have only 29 percent and 8 percent, respectively, of their total trips served by all other means than automobile combined. Almost two thirds of the 29 percent of air passengers using other modes than auto are going to downtown San Francisco. The use of buses by about 5 percent of the employees would likely also be eliminated if it were not for the several hundred United Air Lines Maintenace Base employees who have door-to-door delivery by "Commuter-Club buses" — cooperatively owned and operated special-purpose buses.

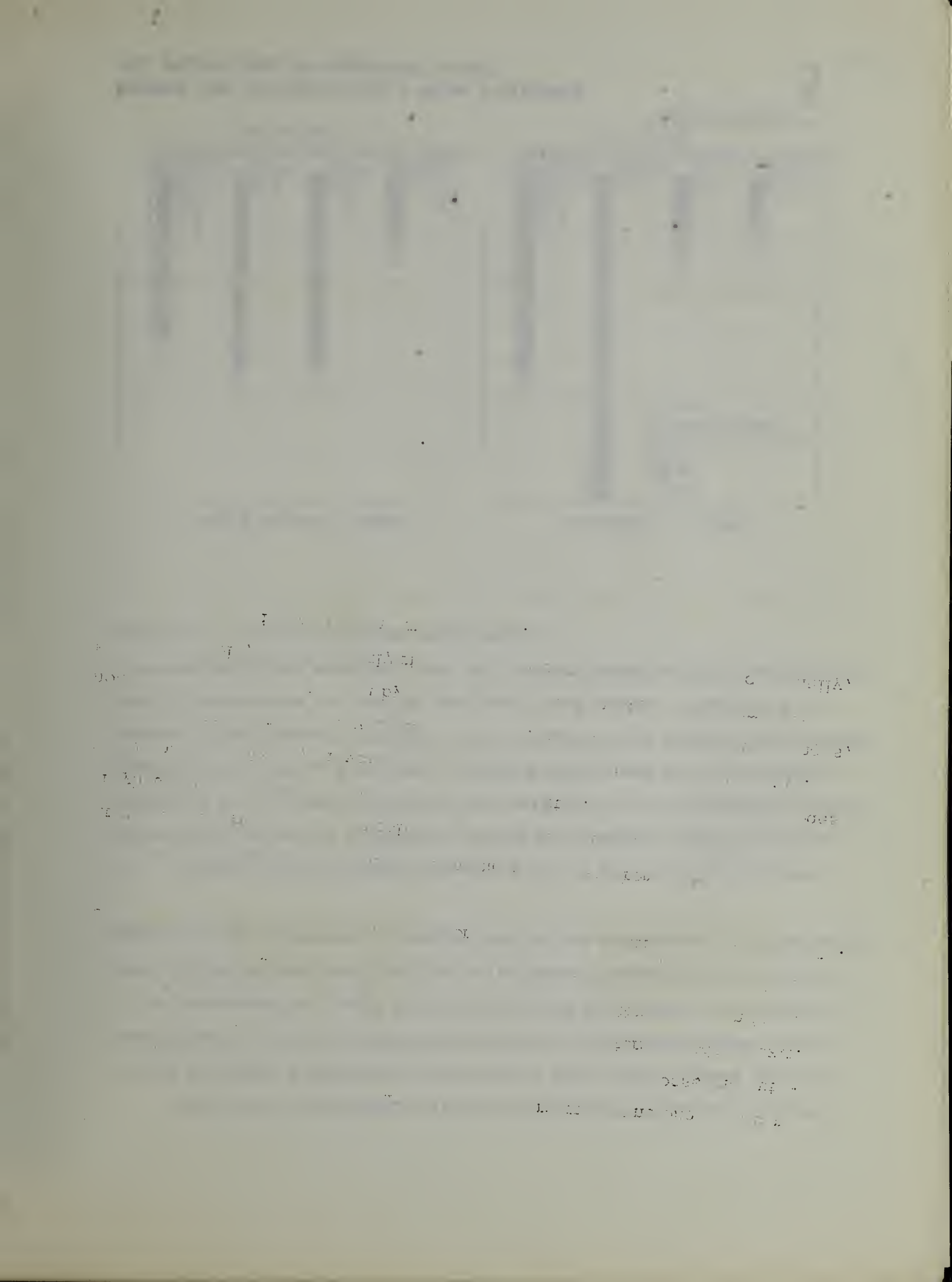
Even the air passengers arriving at the airport with no one in a car to meet them have a significant percentage of their number choose the automobile (rental cars) over public transportation as the preferred mode of exit. Trends throughout the United States indicate that this pattern will continue, even at those airports with good bus or rail transit connections to the CBD, because of the increasing dispersal of origins and destinations of airport users.

Taken in order of usage then, the modes of exit from San Francisco International Airport are automobile, Barrett Bus, taxicab, hotel limousine, Greyhound Bus, Commuter Club bus, and helicopter. The only possible modes remaining are walking, bicycling, horseback riding, and boat or swimming. Because of the distances involved and the hazards of the freeway interchanges, none of these modes are used by more than a tiny number, though some ten to twenty employees apparently ride the Southern Pacific at least occasionally, and walk to the airport from the train station.

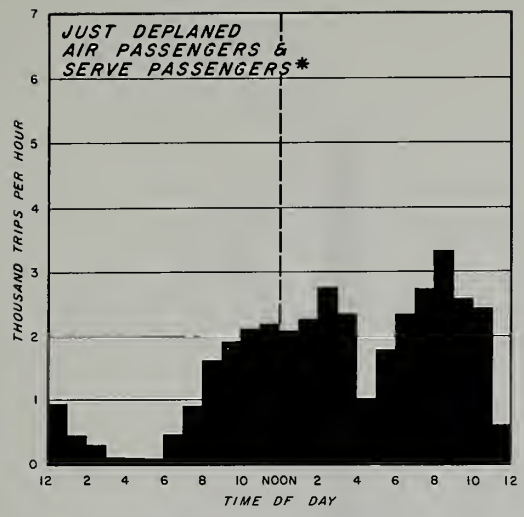


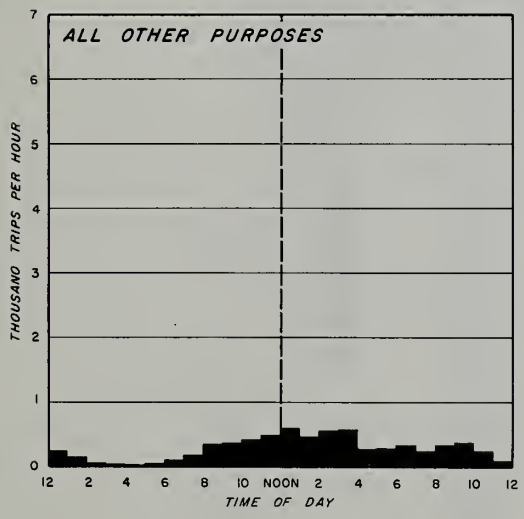
MODE OF DEPARTURE FROM AIRPORT VS. PURPOSE OF AIRPORT VISIT

5

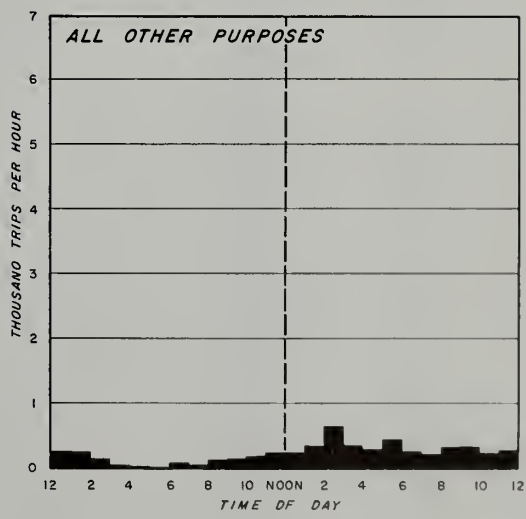


WEEKDAY, 1967





SUNDAY, 1967



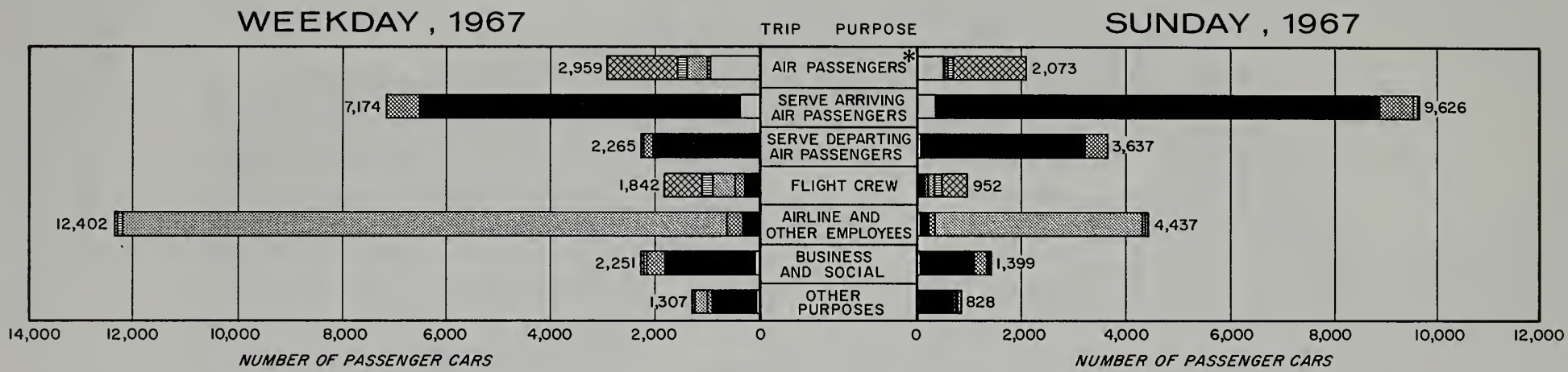
*SERVE PASSENGERS = GREETERS, GOO-SPEEDERS SUITCASE CARRIERS, KISS-AND-RIDERS, ETC

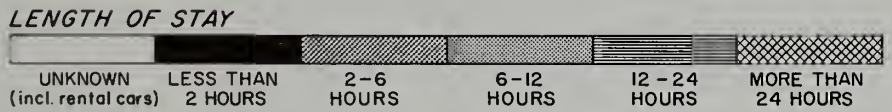
PERSON TRIPS LEAVING AIRPORT BY ALL MODES OF SURFACE TRANSPORTATION

TIME DISTRIBUTION ACCORDING TO PURPOSE OF AIRPORT VISIT

6

SAN FRANCISCO INTERNATIONAL AIRPORT TRAFFIC STUDY



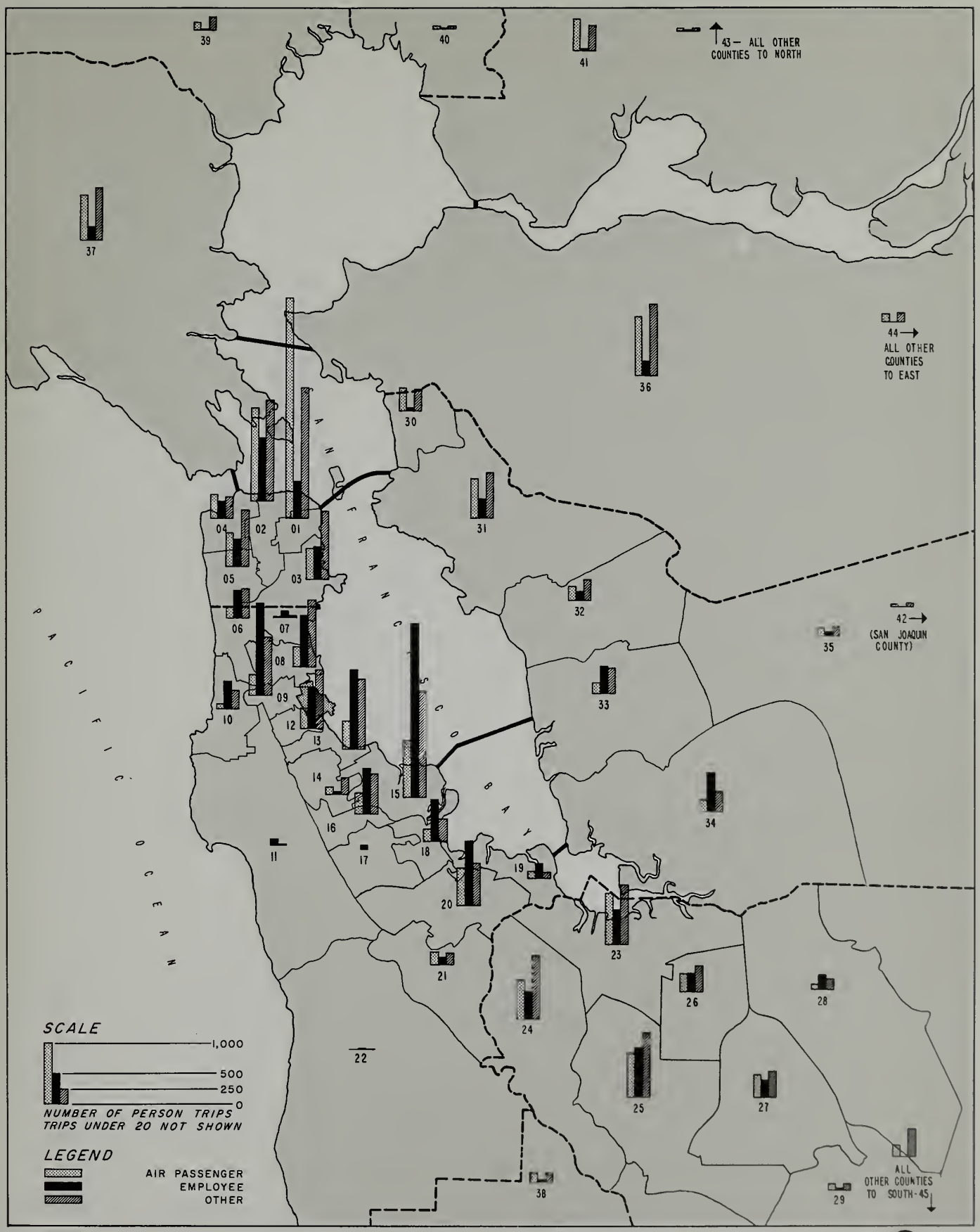


* ARRIVAL AIR PASSENGERS LEAVING AIRPORT BY RENTAL OR PREVIOUSLY PARKED AUTOMOBILES

PARKING DURATION VS. TRIP PURPOSE

7

SAN FRANCISCO INTERNATIONAL AIRPORT TRAFFIC STUDY



8

NORTH

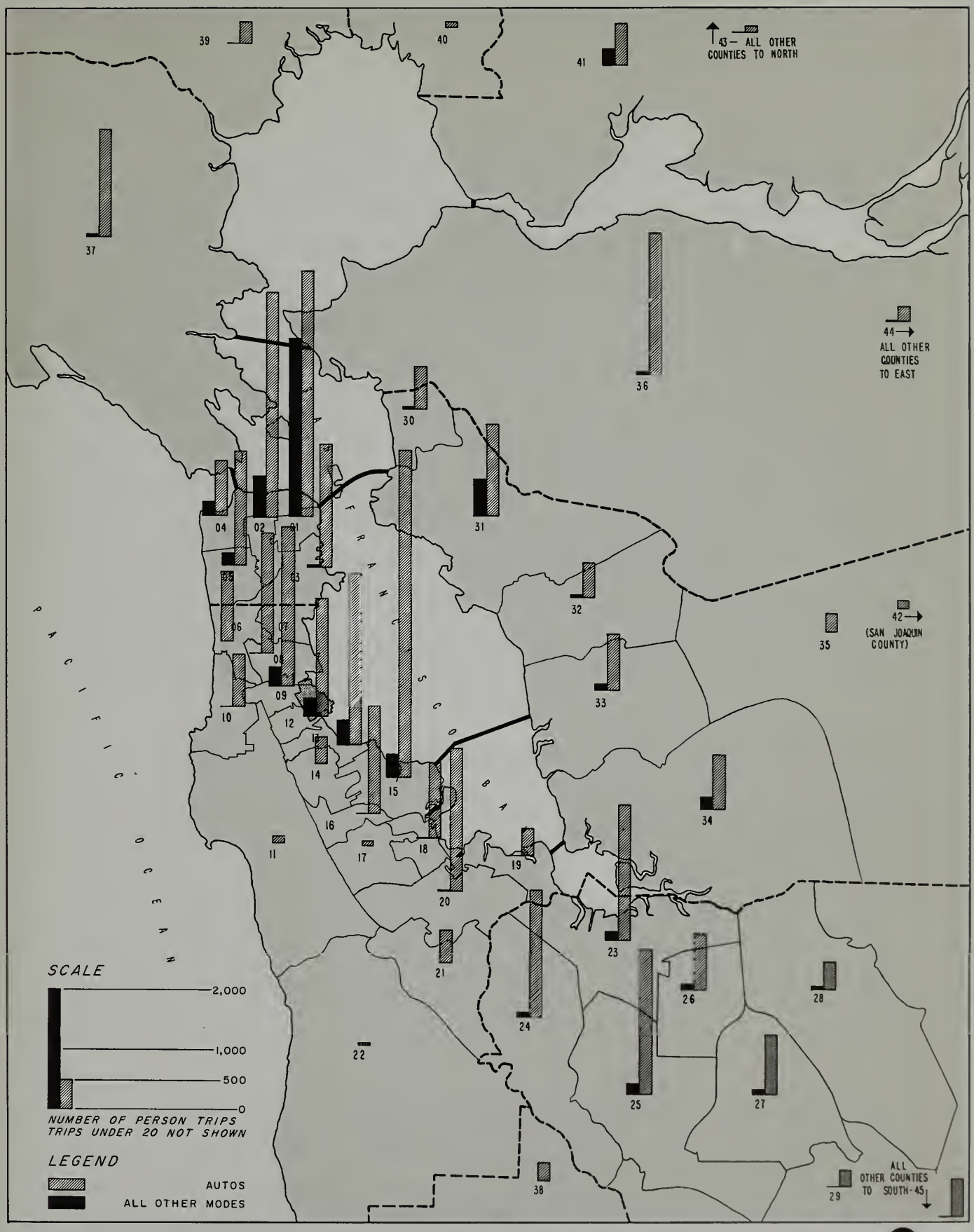
0 2 4 6 8 10 12

SCALE IN MILES

Wilbur Smith & Associates

1967 WEEKDAY PERSON TRIP DESTINATIONS BY THREE PURPOSES

SAN FRANCISCO INTERNATIONAL AIRPORT TRAFFIC STUDY



1967 WEEKDAY PERSON TRIP DESTINATIONS BY AUTO AND ALL OTHER MODES

NORTH

9

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SCALE IN MILES

Wilbur Smith & Associates

SAN FRANCISCO INTERNATIONAL AIRPORT TRAFFIC STUDY

One trip purpose having great significance to airport circulation and parking system planning is the "serve-passenger" trip. This term includes all person-trips to the airport for the purposes of seeing, meeting, dropping off, picking-up, greeting or well-wishing an airline passenger. Without the air passenger, this trip would not exist, but unlike the air-passenger trips, the serve-passenger trips are almost 100 percent by automobile.

In the early days of commercial aviation, and particularly in the early post-war years, it is believed that the ratio of serve-passenger person trips to air-passenger person-trips was four or five to one. Air travel then was still so much a novel event that the whole family came to greet or well-wish the traveler. The current study found (see Tables 10 and 11) that on the weekday, the ratio of serve-passenger person-trips to air-passenger person-trips is about one to one, but on Sunday, it rises to about 1.25 to 1.

This may reflect the fact that a larger number of air-passenger trip-ends on Sunday are home-based, rather than downtown office-based, making public transport less convenient, and requiring more auto serve-passenger trips. It may also reflect a vestige of the post-war feeling that the airport visit is an event, with more than one family member going along on the serve-passenger trip to pick up Father or say goodbye to Aunt Nellie. Indeed, this is indicated by the higher vehicle occupancy on Sundays, shown later, in Table 18.

Converting person-trips to auto-trips shows clearly the importance of the "serve-passenger" trip purpose in airport planning. On the weekday, 3,000 of the automobiles exiting from the airport contained only air passengers (persons who had just arrived on a plane and were now leaving the airport in either a rental car or a private auto, retrieved from a parking lot where it previously had been left). However, 9,400 automobiles exiting the airport only to drop-off, pick up, or greet an air passenger.

On Sunday, the figures are even more marked: Only 2,100 cars contained solely air-passengers, while 13,200 were serve-passengers, while 13,200 were serve-passenger autos.

Besides the very closely related air-passenger and serve-passenger trip purposes, the next most important airport trip purpose is that of employee. This survey separated the employees for convenience into three categories — airline flight crews, all other airline employees, and all other persons employed at the airport.

There is no direct one-to-one relationship between air passenger volume, air cargo volume, landings and take-offs, or other air traffic parameters and the number of employees at the airport; nor is there a close time relationship, as there is between air passengers and serve passengers. However, at San Francisco International Airport, the large number of employees (as indicated in Chapter III) represent 30 percent of the weekday person-trips and have a sizable influence upon the traffic and parking plans, also, and were, therefore given the same attention as the other trip purposes.

The remaining trip purposes were categorized in the survey as "business", "social", and "all others", though combined in the tables. These represent trips to the airport for purposes not related to particular air passengers, and not for employment, but include such "social" reasons as sight-seeing or going to dinner, and such "business" reasons as selling to the shops in the terminal building or arranging shipment of air cargo. Taken together, they represent a significant portion (about 10 percent) of the daily person trips. These three trip purposes are also similar to one another in travel modes used, zones of destination, time of day at airport, and length of time parked.

Origins and Destinations of Airport Users

Since the survey only screened people leaving the airport, the question might well be asked, "What of the trips having the airport as a destination, rather than an origin?" This question was investigated rather carefully at the inception of the study. Because time and funds were limited, and the nature of the survey made it difficult in practice to set up in-bound cordon interview stations without serious traffic congestion, it was deemed wiser to concentrate on trips in one direction only, if evidence could be found indicating that trip characteristics were similar in the other direction.

Some technical references indicated that this assumption of a "mirror-image" of inbound and outbound airport trips would hold true, and preliminary investigation at San Francisco International Airport seemed to confirm this.

Obviously, the "mirror-image" would not hold true for time distribution. However, if good correlation between hour-by-hour air passenger arrivals by air and ground departures could be found, then knowing the flight departure times and passenger loads, one could work backwards to the ground arrivals of air passengers. Evidence of this was presented in a regression analysis study done last year as a research project by the Institute of Transportation and Traffic Engineering, University of California.(1)

Further, evidence in an National Cooperative Highway Research Project study(2) and studies done by the Federal Aviation Agency(3) indicate that both the modes and origins and destinations of air passengers tend to

(1) Vehicular Traffic Patterns at an Airport in Relation to Air Passenger Volumes, Koussios and Homburger, Research Report No. 44, ITTE, University of California.

(2) Urban Travel Patterns for Airports, Shopping Centers, and Industrial Plants, NCHRP Report No. 24, Highway Research Board, p.6.

(3) Manual of Traffic Engineering Studies, Institute of Traffic Engineers, p.58.

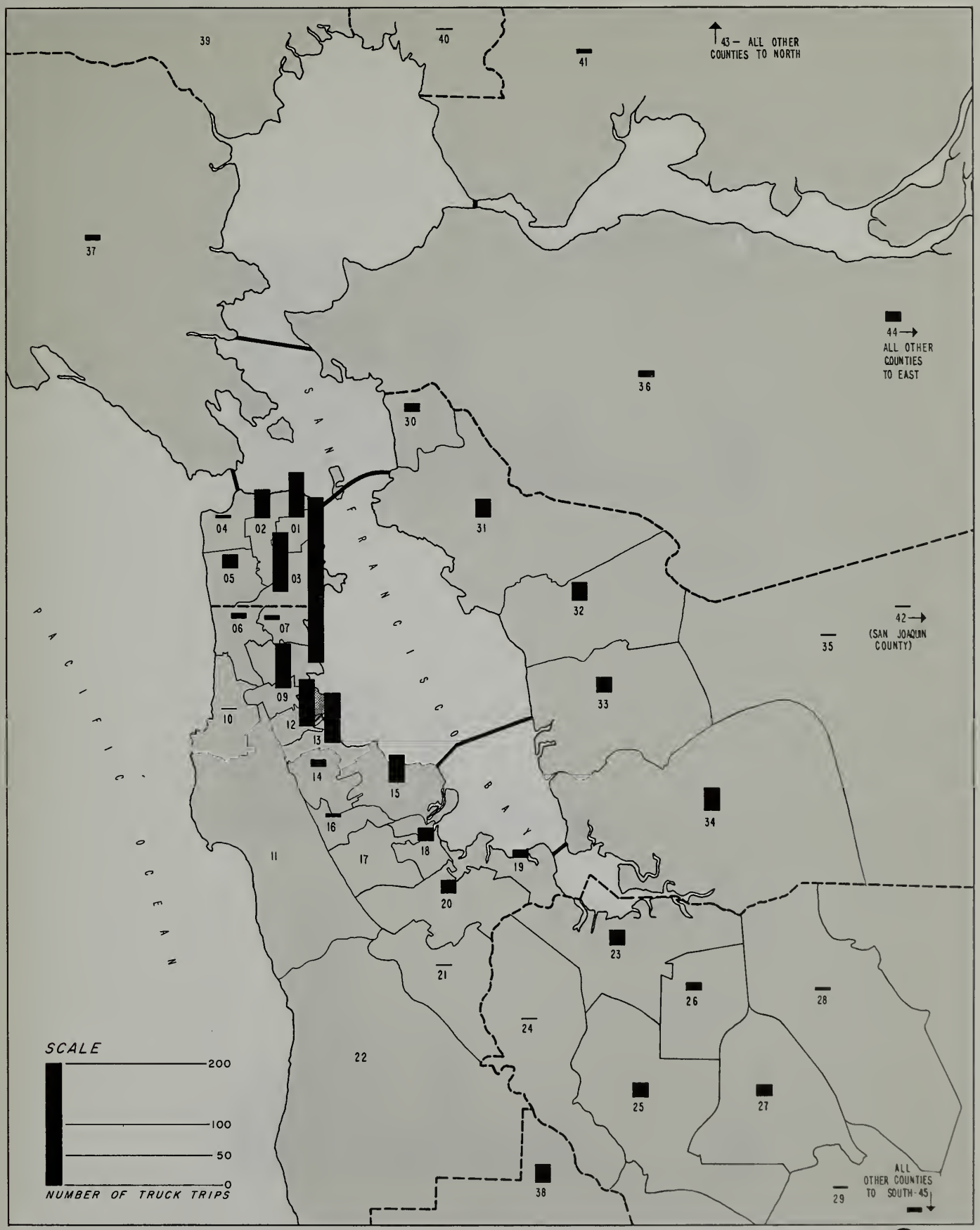
follow the mirror-image theory for a given airport. Employees, serve passengers, and other trips, of course, are known to have a mirror-image characteristic, since most are home-based at both ends and enter and leave by the same mode within a given 24-hour period. This assumption was, therefore, followed in the survey work. The destinations of outbound airport ground trips found in this survey are summarized in Tables 10, 11, 12, and 13, and shown graphically in Figures 8, 9, and 10.

The addresses of destination on survey cards were actually coded and key-punched to census tracts on the San Francisco Peninsula, and to the City and County elsewhere. However, the several hundreds of destination zones resulting from this approach were too unwieldy for this report, and were accordingly grouped as shown in the Tables. (See Table A-1, Appendix, for the equivalents of census tracts to zones.) The groupings follow City and County boundaries or other natural boundaries as nearly as possible, and also attempt to "frame" major transportation arteries to allow some network travel time evaluations by others, if desired.

Analysis of the destination zones was made by both trip purpose and travel mode, and the average trip lengths for various purposes were calculated. Figure 11 illustrates the trip lengths.

Study of these results show a wide variation in destinations of airport users. Downtown San Francisco, as mentioned previously, is the most attractive single zone of destination, with more than half of its trips being air-passenger trips and most of the rest serve-passenger trips San Mateo follows next, but almost half of the trips to San Mateo are by employees.

Looking at trip purposes separately, employees are seen to be largely concentrated on the Peninsula and in the major Eastbay cities, while air- and serve-passenger trips are more widely scattered.



10

NORTH

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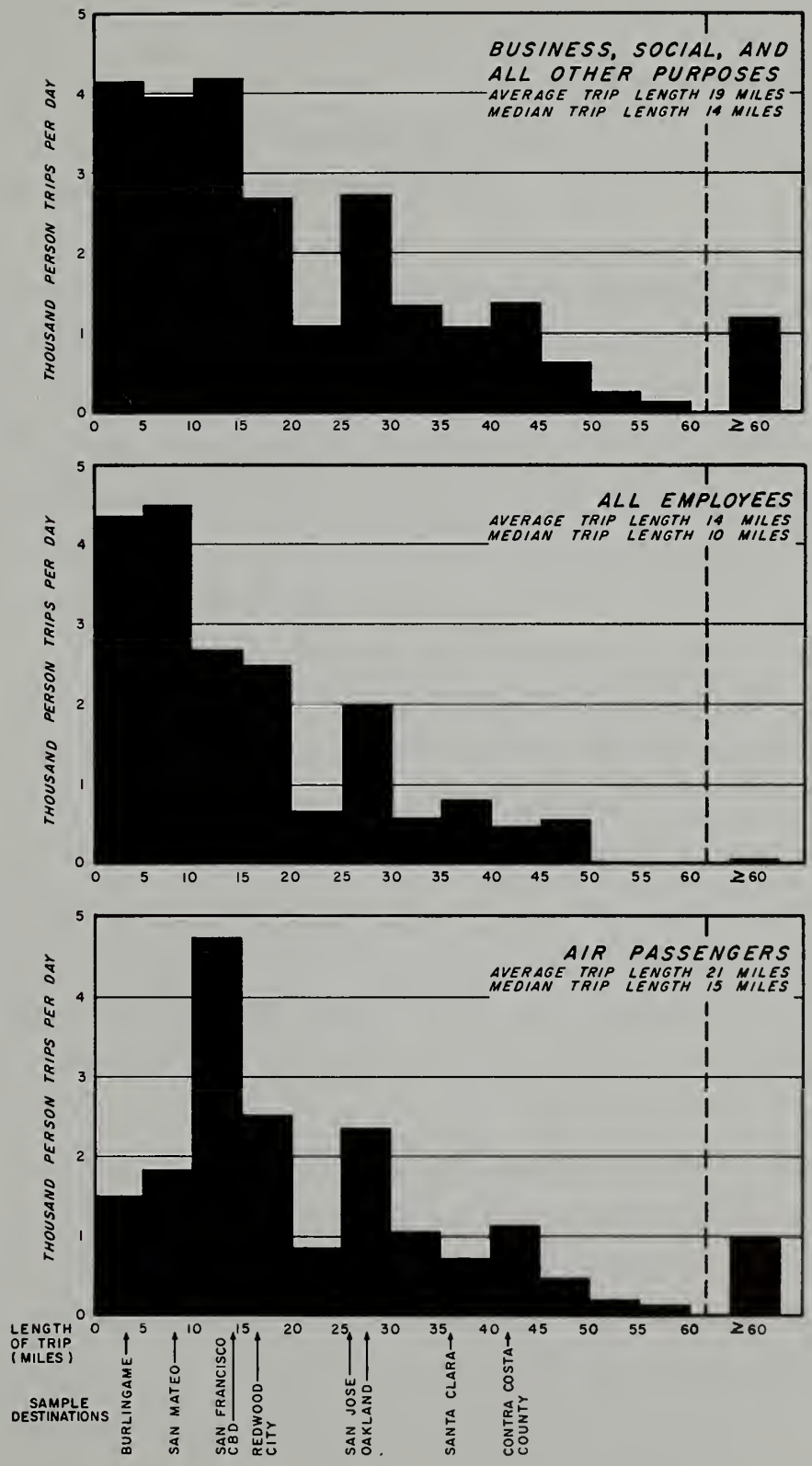
SCALE IN MILES

Wilbur Smith & Associates

DESTINATIONS OF TRUCKS EXITING FROM AIRPORT ON A WEEKDAY, 1967

SAN FRANCISCO INTERNATIONAL AIRPORT TRAFFIC STUDY



DISTRIBUTION OF TRIP LENGTH VS. TRIP PURPOSE ON A WEEKDAY, 1967

Air-passenger trips and serve-passenger trips are very similar in destination, and tend to have the same ratio to one another in each zone that they do in sum. The single exception is the San Francisco Central Area, which undoubtedly includes many business and tourist trips that would not be related to serve-passengers.

The attraction of the various zones of destination for air passenger related trips is apparently dependent upon a number of variables besides distance and population. It would be an interesting and potentially valuable exercise to take the survey data and study this in more detail, using regression analysis on such parameters as population, income, employment, type of land use, etc., to determine the characteristics of areas that produce and attract airport trips.

For example, some of the East Bay zones having denser population and shorter travel times from the airport than other zones actually attract fewer trips. It would be interesting to determine to what extent this is the result of the influence of Oakland Airport, and to what extent the result of parameters mentioned above. The Federal Aviation Agency has done some studies that indicate the air travel generation (or attraction) rates increase with increasing city size and decrease with increasing industrialization.(4)

The graphs and tables clearly indicate the regional nature of San Francisco International Airport and the broad "market area" which it includes. A significant number of ground transportation trips from the airport are destined for such locations as Santa Rosa and Sacramento, which have commercial airports serving them and regularly scheduled commercial flights from San Francisco.

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(4) Air Traffic Patterns and Community Characteristics, FAA, Air Traffic Service, Program Control Division, (1963).

The destinations of airport users by mode are also interesting in terms of potential airport transit service. The wide scatter of trips makes it unlikely that a special purpose airport transit system could be practical except to San Francisco Central Area and possibly San Mateo.

Even the San Francisco Central Area has so few trips compared to the number usually considered as necessary for capitalization and operation of a fixed rail system that any such proposal should be very carefully reviewed. A multi-purpose fixed rail transit system, serving more than just the airport, but with special air passenger luggage-handling facilities might be more feasible if the innate operating problems and a close physical approach to the air terminal could be worked out.

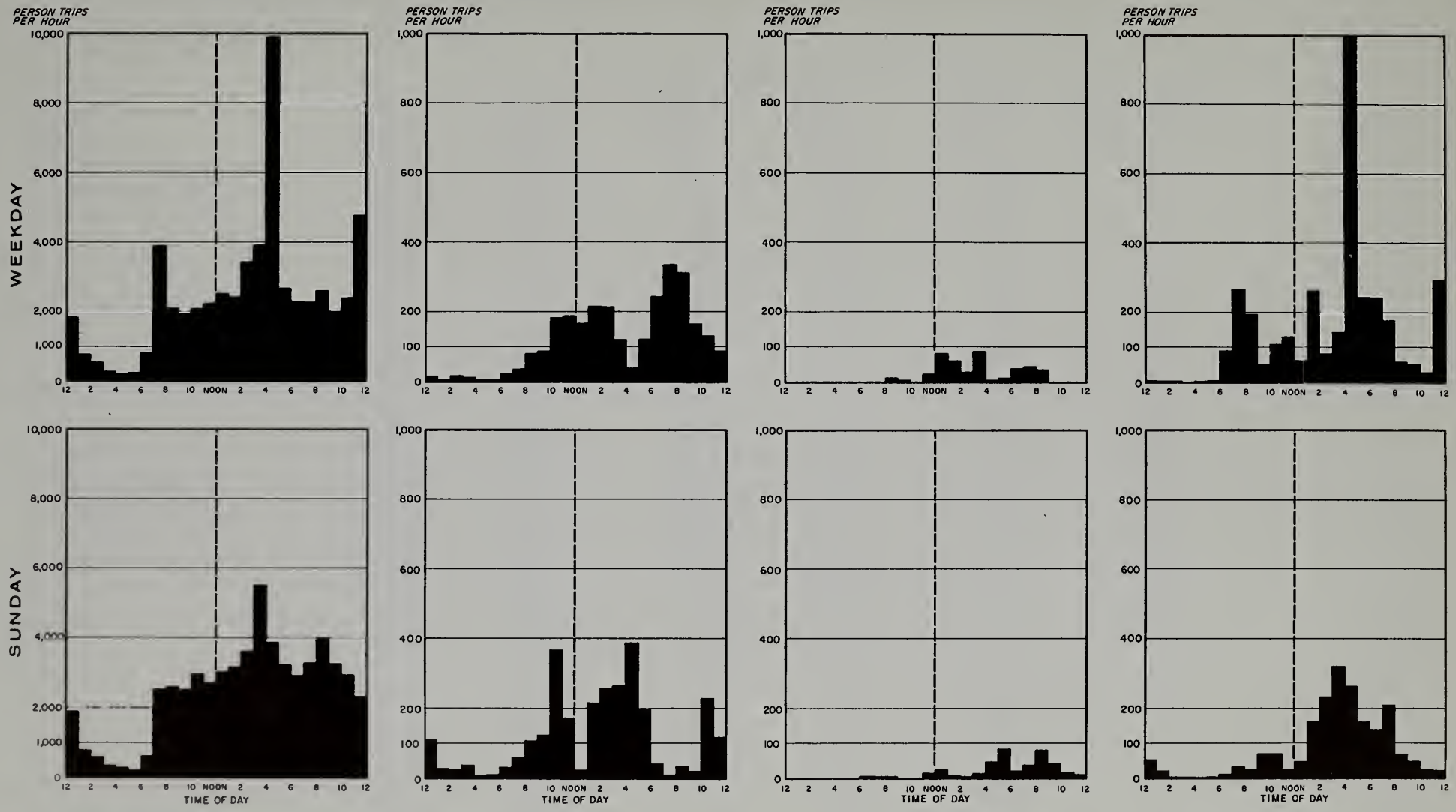
Time Distribution of Airport Trips

Tables 14 and 15 and Figure 12 summarize the daily variation in outflow of persons from the airport, and clearly indicate the peak conditions.

Employee trips, with the exception of the flight crews and some other odd-shift employees, follow the pattern of most major industrial sites having large numbers of employees, with peak movements at the end of each shift. The largest peak occurs at the end of the day shift, which comes between 3:30 and 6:00 P.M. There is some voluntary shift staggering and some imposed by the major employers, which helps to keep this peak period of outflow at a barely tolerable level of congestion.

Air-passenger and serve-passenger trips have their peak outflow in the late afternoon and evening hours, as the heavy volumes of flights begin to arrive. This is the time when most capacity problems occur, because of the overlapping of some employee demands and heavy passenger demands.

This will be more of a problem when more air passengers and serve passengers arrive within a shorter time period, as will happen when the



TIME DISTRIBUTION OF OUTBOUND PERSON TRIPS FROM AIRPORT BY TRANSPORTATION MODE

12

Table 14
OUTBOUND PERSON TRIPS[a] BY HOUR OF DAY AND PURPOSE OF AIPORT VISIT, ON A WEEKDAY, 1967
San Francisco International Airport Traffic Study

DEPART. TIME	PURPOSE OF AIRPORT VISIT: AIR PASS.	SERVE PASS.	BUS. & SOC.	FLT. CREW	OTHER EMPL.	ALL OTHER PURPOSE	TOTAL
12 Mid. - 1 A.M.	330	611	154	86	570	109	1,860
1 A.M. - 2 A. M.	234	240	95	35	132	63	799
2 - 3	155	152	39	62	100	26	534
3 - 4	81	53	9	81	87	22	333
4 - 5	48	62	6	9	43	19	187
5 - 6	43	53	26	26	34	39	221
6 - 7	310	235	17	46	293	87	988
7 - 8	554	489	48	47	1,999	137	3,274
8 - 9	857	901	117	49	398	241	2,563
9 - 10	823	1,106	144	53	119	236	2,481
10 - 11	1,177	1,005	267	79	121	165	2,814
11 - 12 Noon	1,094	1,175	265	125	157	234	3,050
12 Noon - 1 P.M.	1,024	1,084	419	196	312	183	3,218
1 -2 P. M.	1,255	1,117	309	132	193	234	3,240
2 - 3	1,238	1,541	330	201	464	270	4,044
3 - 4	1,309	1,138	287	247	841	295	4,117
4 - 5	784	440	94	95	6,743	192	8,348
5 - 6	1,205	711	181	106	506	116	2,825
6 - 7	1,576	964	203	115	176	141	3,175
7 - 8	1,761	1,090	105	192	88	159	3,395
8 - 9	1,850	1,494	172	140	88	171	3,915
9 - 10	1,300	1,271	224	91	59	164	3,109
10 - 11	1,152	1,310	138	131	320	111	3,162
11 - 12 P. M.	344	280	54	72	2,954	51	3,755
Hour Unknown	198	31	14	7	129	84	463
TOTAL	20,702	18,553	3,717	2,423	16,926	3,549	65,870

(a) Approximately 1,050 hotel limousine person trips not included in this table because of insufficient data on time distribution.

Table 15
OUTBOUND PERSON TRIPS[a] BY HOUR OF DAY AND PURPOSE OF AIRPORT VISIT, ON A SUNDAY, 1967
San Francisco International Airport Traffic Study

DEPART. TIME	PURPOSE OF AIRPORT VISIT: AIR PASS.	SERVE PASS.	BUS. & SOC.	FLT. CREW	OTHER EMPL.	ALL OTHER PURPOSE	TOTAL
12 Mid. - 1 A.M.	329	297	176	21	683	79	1,585
1 A.M. - 2 A.M.	204	286	126	14	79	115	824
2 - 3	108	87	109	35	69	27	435
3 - 4	87	69	28	63	35	21	303
4 - 5	138	74	13	15	26	10	276
5 - 6	58	89	8	24	32	6	217
6 - 7	165	137	4	38	129	79	552
7 - 8	413	608	18	39	684	49	1,811
8 - 9	790	1,329	31	17	423	85	2,675
9 - 10	992	1,831	56	44	66	65	3,054
10 - 11	1,690	2,153	93	30	85	100	4,151
11 - 12 Noon	1,045	1,598	158	70	171	101	3,143
12 Noon - 1 P.M.	1,250	1,992	187	59	66	65	3,619
1 - 2 P. M.	1,408	1,907	293	54	121	121	3,904
2 - 3	1,496	1,899	419	68	327	238	4,447
3 - 4	2,297	2,640	202	125	631	173	6,068
4 - 5	1,306	1,360	191	47	942	113	3,959
5 - 6	1,521	1,792	293	86	164	161	4,017
6 - 7	1,215	1,652	295	63	83	53	3,361
7 - 8	1,607	1,884	191	84	15	30	3,811
8 - 9	1,811	2,078	223	98	20	96	4,326
9 - 10	1,389	1,618	235	89	75	94	3,500
10 - 11	1,056	1,695	105	93	272	128	3,349
11 - 12 P. M.	504	633	168	49	489	113	1,956
Hour Unknown	239	4	12	2	118	2	377
TOTAL	23,118	29,712	3,634	1,327	5,805	2,124	65,720

(a) Approximately 1,050 hotel limousine and 600 Greyhound Bus person trips not included in this table because of insufficient data on time distribution.

Boeing 747 "Jumbos," carrying up to 500 passengers, are put in service in 1969.

At the present time, for every three air passengers arriving at San Francisco International Airport in the peak hour of 8:00 to 9:00 P.M., two air passenger and serve passenger autos wish to exit from the airport the next hour, besides employees and others. If 25 arriving flights can now deplane 2,100 passengers in one hour, putting 1,400 cars on the main exit road, not counting employee vehicles; then, a similar 25 flights in the era of the "Jumbo" could theoretically deplane more than 10,000 persons and put 6,700 cars on the main exit road in an hour! Since the peak hours are congested now, the magnitude of the problem is clear.

Other Trip Characteristics

An important characteristic of airport auto trips is the type of parking sought. Figure 7 and Tables 16 and 17 give details of the relationship between airport trip purposes and parking needs.

It is readily apparent by comparing Table 6 with Tables 16 and 17 that the demands for curb space at the terminal building during periods of heavy air passenger arrivals and departures are presently greater than the supply. Taking the ratio of air-and serve-passenger auto trips that now use terminal curb space to the air-and serve passenger-trips now using public parking facilities (Tables 16 and 17) and applying the rule of thumb mentioned in the previous sub-chapter (two air and/or serve passenger autos for every three arriving air passengers), one can estimate the requirements for auto curb space and for high turnover parking in the public garage for various hourly levels of arriving air passengers.

Again, it is apparent that in the "Jumbo" era, curb capacity simply will not permit present passenger and luggage loading patterns to occur, and more intensive use of the garage will be required. It also indicates

Table 16
TYPE OF PARKING USED VERSUS PURPOSE OF AIRPORT VISIT,
ON A WEEKDAY, 1967
San Francisco International Airport Traffic Study

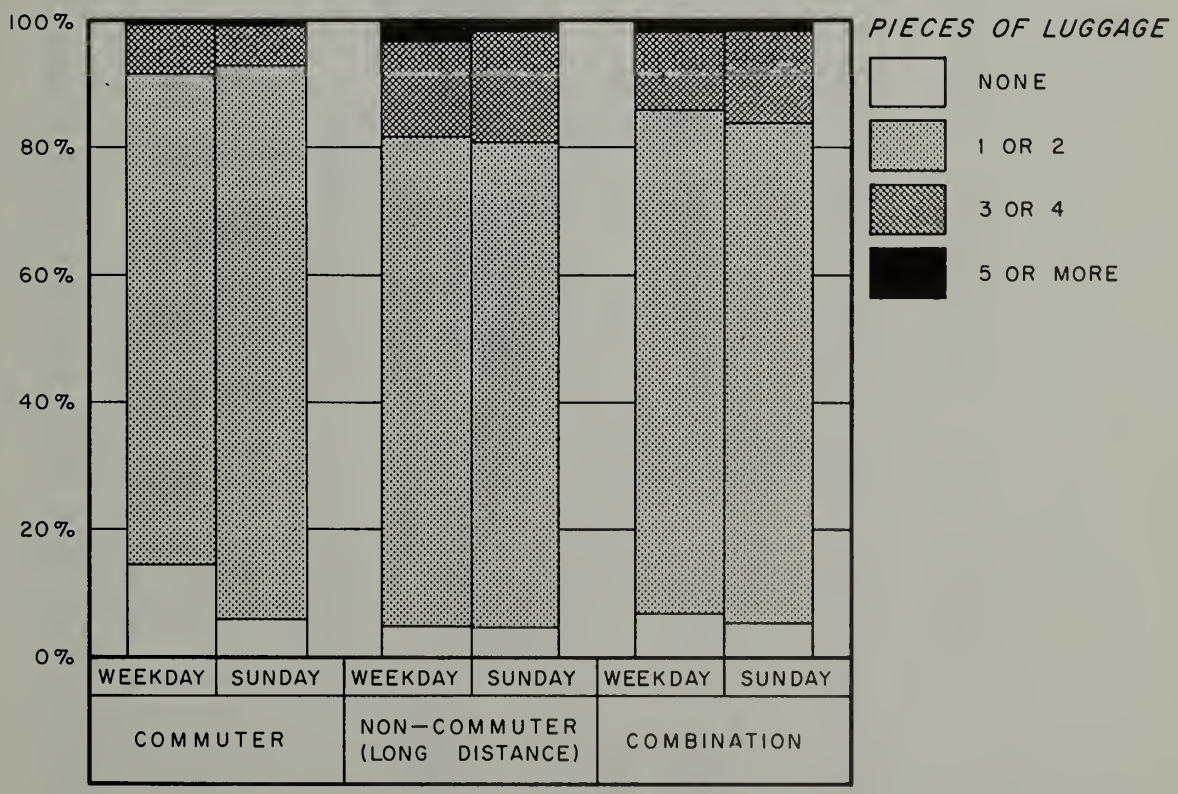
TYPE PARKING USED \ PURPOSE OF AIRPORT VISIT	NUMBER OF AUTOMOBILES LEAVING AIRPORT				
	AIR PASS.	SERVE PASS.	BUS.,SOC. & OTH. PURPOSE	ALL EMPL.	TOTAL
Public Parking Lot or Garage	1,884	5,961	783	357	8,985
Employee Lot	86	74	596	13,349	14,105
Terminal Bldg. Curb Space	70	2,990	549	178	3,787
Visitor or Reserved Space	16	212	1,200	263	1,691
Car came from Rental Car Lot	880	176	176	77	1,309
Did Not Park	23	27	258	21	329
TOTAL	2,959	9,440	3,562	14,245	30,206

the need to place parking "sectors" in the garage, with short-term facilities closest to the terminal, and long-term facilities further away; and the need for luggage check-in and claim areas within the garage itself.

Because of the importance of the luggage problem, and its impact upon the potential usage of transit, as well as curb space requirements, acceptable parker walking distances, and baggage-handling facilities needs, all air passenger trips were analyzed for patterns of luggage quantity. Table 18 and Figures 13 and 14 show groupings of the amount of luggage handled per air passenger by type of airline and by transit mode. Studies were also made of the luggage per air passenger by time of day and by district of destination, but no clear-cut or meaningful patterns emerged.

Table 17
TYPE OF PARKING USED VERSUS PURPOSE OF AIRPORT VISIT,
ON A SUNDAY, 1967

TYPE PARKING USED \ PURPOSE OF AIRPORT VISIT	NUMBER OF AUTOMOBILES LEAVING AIRPORT				
	AIR PASS.	SERVE PASS.	BUS.,SOC.& OTH. PURPOSE	ALL EMPL.	TOTAL
Public Parking Lot or Garage	1,558	9,167	785	226	11,736
Employee Lot	56	72	192	4,895	5,215
Terminal Bldg. Curb Space	28	3,594	422	107	4,151
Visitor or Reserved Space	17	183	532	99	831
Car came from Rental Car Lot	403	189	60	34	686
Did Not Park	13	62	236	26	337
TOTAL	2,075	13,267	2,227	5,387	22,956



PERCENTAGE DISTRIBUTION OF THE AMOUNT OF LUGGAGE VS. TYPE OF AIRLINE ON WEEKDAY AND SUNDAY, 1967

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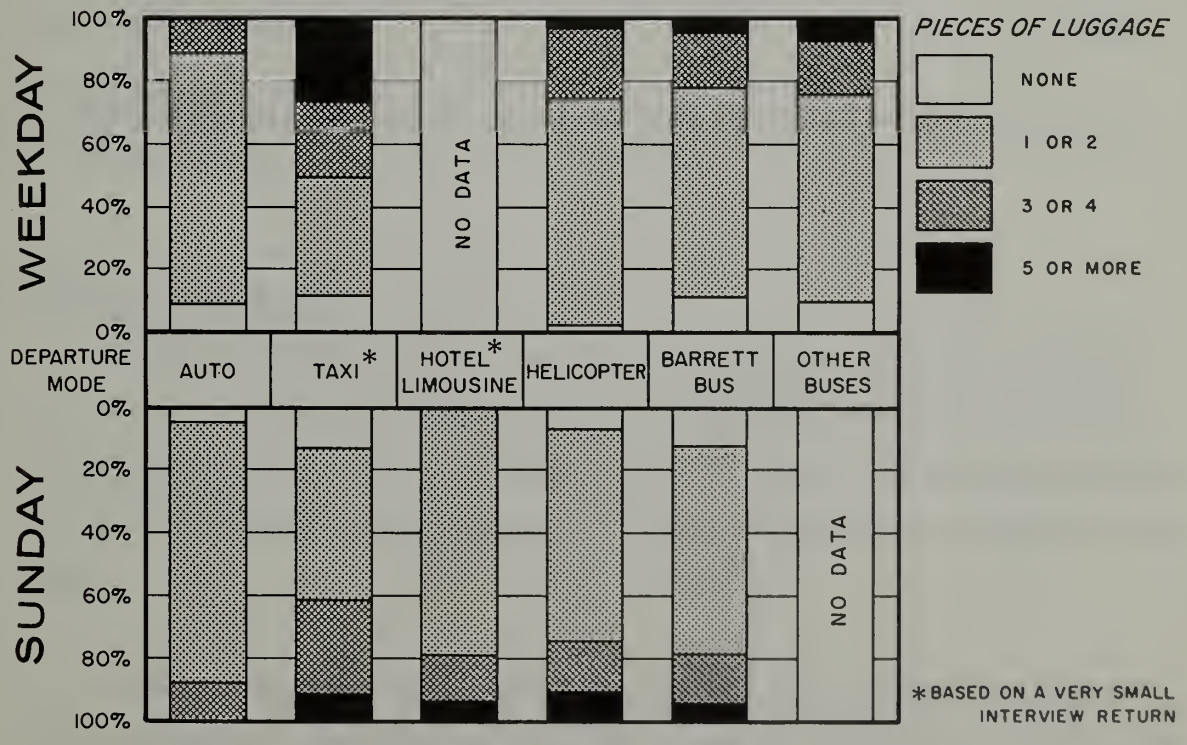
Table 18
AMOUNT OF LUGGAGE CARRIED PER AIR PASSENGER VERSUS TYPE OF AIRLINE
ON WEEKDAY AND SUNDAY, 1967
San Francisco International Airport Traffic Study

PIECES OF LUGGAGE	TYPE OF AIRLINE: COMMUTER				NON-COMMUTER (LONG DISTANCE)				COMBINATION				NOT IDENTIFIED	
	WEEKDAY		SUNDAY		WEEKDAY		SUNDAY		WEEKDAY		SUNDAY		WEEK-DAY	SUN-DAY
	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	No.
None	757	14.8	376	6.1	157	5.0	159	5.0	650	6.9	545	5.3	119	120
1 or 2	3,927	77.0	5,316	86.7	2,395	76.8	2,416	75.5	7,390	78.9	8,083	78.3	1,085	1,297
3 or 4	400	7.9	405	6.6	465	14.9	561	17.6	1,172	12.5	1,515	14.7	185	191
5 and More	12	0.3	34	0.6	103	3.3	61	1.9	159	1.7	172	1.7	19	27
TOTAL	5,096	100.0	6,131	100.0	3,120	100.0	3,197	100.0	9,371	100.0	10,315	100.0	1,408	1,635

Figure 13 and Table 18 show a pattern one would expect — that the airlines carrying longer distance trips from San Francisco have more luggage per passenger, while the commuter-type runs have least. Figure 14 shows up an unexpected pattern — that a significant number of air passengers using public transportation for airport trips carry more luggage than those using the automobile. This may reflect the tourist's impact, if the stereotype of the tourist with more luggage than he needs is a true one, because the tourist would tend to use taxicabs, hotel limousines and Barrett Bus.

Table 19 shows another important characteristic of auto trips — the vehicle occupancy by trip purpose. The variation from weekday to Sunday in car occupancy rates is as great as the variation from one trip purpose to another.



PERCENTAGE DISTRIBUTION OF THE AMOUNT OF LUGGAGE PER AIR PASSENGER BY DEPARTURE MODE

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Table 19
AVERAGE CAR OCCUPANCY FOR EACH TRIP PURPOSE
ON WEEKDAY AND SUNDAY, 1967
San Francisco International Airport Traffic Study

TRIP PURPOSE	AVERAGE CAR OCCUPANCY	
	WEEKDAY	SUNDAY
Air Passengers[(a)]	1.46	1.79
Serve Arriving Air Passengers	3.37	3.60
Serve Departing Air Passengers	2.39	2.65
Business	1.43	2.17
Social	2.24	2.66
Flight Crew	1.25	1.28
Airline Employees	1.37	1.23
Other Airport Employees	1.22	1.21
Other Purposes	1.75	2.24
Total All Purposes	1.94	2.61

(a) Arrival air passengers leaving airport by rental or previously parked automobiles.

Trucks At The Airport

While many hundreds of thousands of dollars have been spent in development of more efficient air cargo systems for airports and airlines, almost no research has been done on the other side of the air cargo terminal — the impact of air cargo volumes upon roadway and truck-loading requirements.

Since classification counts taken at the airport indicated that 5 percent or more of the vehicles on-airport roadways were trucks, the survey gave trucks special attention. Figure 10 and Tables 21 through 25 summarize the most important information found in the survey.

Table 20
DESTINATION OF TRUCKS AFTER LEAVING AIRPORT
San Francisco International Airport Traffic Study

	WEDNESDAY	SUNDAY
Next Delivery or Pickup	351	96
Terminal or Warehouse	438	49
Drives Home	293	66
Other	100	15
TOTAL	1,182	226

Unlike passengers, air cargo can be stored in the cargo buildings for periods of hours without complaining, and so there is no close hour-by-hour connection between the number of trucks on airport roads and the volume of air cargo being flown in and out. However, there is certainly a relationship between the daily truck volumes and air cargo volumes, though that relationship no doubt varies with the type of freight being handled.

Table 21
PURPOSE OF TRUCK TRIP TO AIRPORT
San Francisco International Airport Traffic Study

	WEDNESDAY	SUNDAY
Deliver Air Cargo	352	51
Pickup Air Cargo	198	31
Airmail	56	66
Other Goods[(a)]	200	18
Other Purposes[(b)]	374	62
Combination	0	0
TOTAL	1,180	228

(a) Restaurant supplies, etc.
(b) Includes utility service trucks, tow trucks, etc.

Past design of San Francisco International Airport roadway systems have not given enough attention to truck needs, with resulting inadequate curb return radii, lane widths, median designs and structure clearances. With air cargo volumes growing even faster than air passenger volumes, trucks may occupy a still greater portion of the traffic mix, and certainly warrant special design attention.

Table 21 summarizes the numbers of trucks exiting from the airport by their trip purpose, reflecting the relative importance of air freight, air mail, and non-flight goods delivery to airport tenants.

Table 22 shows the time distribution of departing trucks. The peak truck movements are in the afternoon, at the same time employee and air-passenger trips are at fairly high levels. It only takes one stopped tractor-trailer in the traffic stream at heavy levels of flow to bring serious congestion.

Table 23 shows the types of goods handled by trucks. Delivery of flowers, food and perishables, being the least amenable to storage, must follow airline schedules more closely than the others and pose different handling problems.

A significant number of trucks, besides those exiting, are used for intra-airport services delivery, and transfer by the air freight forwarders and the airlines themselves.

Table 22
DEPARTURE TIME VERSUS TRUCK TRIP PURPOSE
San Francisco International Airport Traffic Study

HOUR OF DAY	DELIVERED AIR CARGO		PICKED UP AIR CARGO		DELIVERED OR PICKED UP AIRMAIL		DELIVERED GOODS OTHER THAN MAIL OR AIR CARGO		OTHER PURPOSES		TOTAL	
	Wed.	Sun.	Wed.	Sun.	Wed.	Sun.	Wed.	Sun.	Wed.	Sun.	Wed.	Sun.
12 Mid. - 1 A.M.	2	0	0	4	2	4	2	4	8	11	14	23
1 A.M. - 2 A. M.	3	2	6	0	0	5	0	0	5	2	14	9
2 - 3	0	5	1	0	2	0	0	0	0	0	3	5
3 - 4	4	0	0	0	3	4	3	0	4	0	14	4
4 - 5	1	0	1	0	0	3	0	0	2	0	4	3
5 - 6	1	0	2	0	1	0	0	3	0	3	4	6
6 - 7	2	0	3	0	2	13	1	0	7	3	15	16
7 - 8	4	0	9	0	0	0	6	4	11	0	30	4
8 - 9	23	0	26	12	4	6	20	0	23	4	96	22
9 - 10	35	0	37	0	9	0	19	4	23	6	123	10
10 - 11	36	15	21	0	0	6	26	3	19	0	102	24
11 - 12 Noon	39	6	14	0	16	0	24	0	23	4	116	10
12 Noon - 1 P.M.	30	0	3	0	7	0	21	0	31	0	92	0
1 - 2 P.M.	14	0	17	4	0	4	8	0	12	0	51	8
2 - 3	15	3	7	9	0	3	23	0	54	0	99	15
3 - 4	3	0	17	0	0	0	21	0	51	4	92	4
4 - 5	48	4	7	0	0	0	0	0	7	4	62	8
5 - 6	36	3	0	0	0	0	5	0	6	0	47	3
6 - 7	6	0	7	0	1	0	1	0	9	4	24	4
7 - 8	22	0	4	0	0	2	0	0	0	2	26	4
8 - 9	9	5	8	2	0	2	0	0	9	0	26	9
9 - 10	9	0	0	0	0	4	0	0	8	0	17	4
10 - 11	4	0	1	0	1	2	4	0	4	12	14	14
11 - 12	5	5	2	0	3	10	3	0	7	5	20	20
Unknown	3	0	7	0	7	0	14	0	52	0	83	0
TOTAL	354	48	200	31	58	68	201	18	375	64	1,188	229

Table 23
TYPE OF FREIGHT OR GOODS HANDLED BY TRUCKS EXITING AIRPORT
San Francisco International Airport Traffic Study

	WEDNESDAY	SUNDAY
Mail	73	65
Flowers, Food and Perishables	156	33
Equipment, Machinery, Electronic Parts	239	12
Supplies and Dry Goods	105	18
Fuel for Aircraft	26	0
Packages and Parcels	98	17
Combination of Above	155	12
Unknown	134	14
Other[(a)]	203	53
TOTAL	1,189	224

(a) "Other" includes utility service trucks, etc.

Major Implications of Survey

The transportation survey provided broad-based facts that have thrown a great deal of light on previously hazy relationships. While questions remain to be answered, one is now in a position to know how to go about getting the answers and perhaps, more importantly, what questions to ask.

For the first time, a good picture has been obtained of the size and travel characteristics of that large group at the airport called "serve passengers", and the implications they have for parking, roadway and terminal needs.

Also for the first time, an accurate accounting of the Bay Area origins and destinations of all San Francisco Airport users is available for study, with potential value not only to airport plans, but to air travel market studies, highway planning efforts, transit studies and regional governmental agencies.

The value of this study will be enhanced by periodic testing of some of the key parameters, thereby affording accurate information about the trends in car and transit usage, airport service or market area, vehicle occupancy, and the ratio of air-passengers to serve-passengers. By doing this, airport planners will have their finger on the pulse all the time, and flexibility in planning will be possible.

It is recommended that such follow-up testing by sampling techniques be undertaken at least annually by the airport.

Table 24
SIZES OF TRUCKS EXITING AIRPORT
San Francisco International Airport Traffic Study

	WEDNESDAY	SUNDAY
2-Axle[(a)]	945	174
3-Axle	99	18
4-Axle	41	11
5-Axle	20	8
6-Axle	14	0
Other	66	10
TOTAL	1,185	221

(a) Includes some pickups and vans as well as dual wheel 2-axle trucks.

Table 25
LOCATIONS OF AIRPORT TRUCK STOPS BY TRUCK PURPOSE
San Francisco International Airport Traffic Study

AIRPORT ZONE / TRUCK PURPOSE	NUMBER OF STOPS BY TRUCK PURPOSE											
	DELIVERED AIR CARGO		PICKED UP AIR CARGO		DELIVERED OR PICKED UP AIRMAIL		DELIVERED GOODS OTHER THAN MAIL OR AIR CARGO		OTHER PURPOSES		TOTAL	
	Wed.	Sun.	Wed.	Sun.	Wed.	Sun.	Wed.	Sun.	Wed.	Sun.	Wed.	Sun.
Central Terminal	10	0	6	0	0	0	35	6	71	0	122	6
South Terminal	5	0	1	0	0	0	18	0	34	12	58	12
Airmail Handling Facilities	10	0	0	0	34	59	19	0	0	0	63	59
TWA Hanger	51	10	13	7	0	0	18	0	25	4	107	21
PAN AM Hangar	13	0	0	0	5	0	14	0	18	6	50	6
American Hangar	21	0	20	0	0	0	10	4	9	0	60	4
Pacific Hangar	4	0	0	0	0	0	13	0	10	0	27	0
United Hangar and Freight	124	17	53	3	7	0	17	4	34	18	235	42
United Maintenance	0	0	0	0	0	0	9	0	16	0	25	0
Cargo Buildings	76	11	77	20	5	6	8	0	22	4	188	41
Fuel Storage Areas	0	0	0	0	0	0	9	0	6	3	15	3
Hilton Hotel	0	0	0	0	0	0	6	0	1	0	7	0
Other	11	5	0	0	0	0	24	0	94	15	129	20
Multiple Stops	30	5	31	0	6	0	2	4	31	0	100	9
TOTAL	355	48	201	30	57	65	202	18	371	62	1,186	223

Chapter V

FUTURE PROJECTIONS

Effects of Employment Growth

The anticipated growth in airport employees of more than 50 percent within the next four years, as estimated by the airport tenants themselves, is only partially dependent upon growth in air passenger and cargo volumes at San Francisco International Airport. A large portion of the employment growth will be in new maintenance facilities by such tenants as United Air Lines, Western Air Lines, Pacific Air Lines, and Qantas, and will reflect the general growth of aviation, as well as San Francisco International Airport growth.

As a result, the employment of the airport will tend more and more to be like that of major industrial plants, with three regular shifts and very heavy peaks at shift ends.

The requirements for parking and roadway capacity to handle these peaks will be severe at best, and will require modification to the greatest possible extent by shift staggering and careful selection of times for shift ends.

Projections of future employment are listed below in two parts: First, for the employment resulting from expansion at maintenance facilities; and second, for the employment expected to result from aviation growth at San Francisco International Airport. The employment in connection with new maintenance facilities is restrained beyond 1971 by land limitations.[(a)]

	Present	1971	1975[(a)]
Number of aircraft maintenance base employees	11,000	18,000	20,000
Number of other employees	10,000	15,000[(b)]	20,000[(b)]

(a) Land requirements for maintenance facilities beyond those presently planned for the 1971 level will be extremely difficult to meet unless additional expansion into the bay is permitted.

(b) These figures are based upon assumption of 18,000,000 air passengers in 1971 and 24,000,000 in 1975, which may or may not be accurate projections.

If present patterns of shift splits and automobile usage continue, as anticipated, the effect of these employment figures upon traffic needs will be as follows:

	Present	1971	1975
Peak parking Requirements	7,000 spaces	11,000 spaces	14,000 spaces
Peak capacity Requirements (For outbound employees only -- does not include other trip purposes)	4,000 vehicles/hour	6,500 vehicles/hour	8,000 vehicles/hour

The parking requirements in 1971 for employees alone will require an additional 28 acres or 1,200,000 square feet of parking area be added. The capacity needs at the 1971 level will require an additional three to six lanes of exit capacity for employees alone, even with some shift staggering.

Effects of Air Passenger Growth

Rather than attempt to predict the total level of demand for airport parking, roadway and transit facilities in particular years, as done for the maintenance base employees alone, the effect of increments of air passenger growth on these facilities has been examined, with no reference to year. If, then, the growth in air passenger volume takes place either faster or slower than expected, one can graph the growth against time, and recalculate the expected date of reaching each level.

At the time of this report writing, early winter, 1967, it appeared that the annual in and out passenger level at the end of 1967 would exceed 12,000,000 passengers, or a growth of almost 15 percent over the previous year.

For the purpose of this study, three benchmark passenger levels have been set, at 12,000,000, 18,000,000, and 24,000,000 annual air passengers, respectively. Present study conditions are represented by the 12,000,000 annual level. In daily terms, the present level works out at about 35,000 passengers per day.

Table 26 summarizes the impact upon transportation requirements of each benchmark level. However, it is important to point out that the peak hour projections in Table 26 assume that peak hour airline movements will remain at the same percentage level of daily airline movements as at present. In fact, this percentage level may be higher, because it will depend upon how many 747 passenger "Jumbos" or other large aircraft land and take off in the peak periods. In order to avoid the serious problems suggested in Chapter IV, it may be necessary for airport, Federal Aviation Agency, or airline officials to impose control restrictions upon flight time schedules.

Table 26 also assumes the same percentages of usage of garage, transit and curb facilities as exist at present.

Table 26 does not include the employee or other trip purposes, and should not be used for design. It is intended only to indicate the portion of total trips that results from increases in numbers of air passengers at the airport.

The air-passenger and serve-passenger garage and terminal curb space requirements tend to affect each other also. Generally, the fewer air passengers using curb space, the more the garage will be used, and vice versa. As indicated in Chapter IV, the curb space able to be provided is insufficient, and the effect of that capacity restraint, with proper garage and baggage-handling design will be to increase turnover parking in the garage.

Table 26
EFFECTS OF AIR PASSENGER GROWTH
San Francisco International Airport Traffic Study

TRANSPORTATION FACILITY		AIR PASSENGER LEVEL 12,000,000[a] ANNUAL	18,000,000[b] ANNUAL	24,000,000[c] ANNUAL
Terminal[d] Curb Loading Space	Daily	-	-	-
	Peak-Hour	4,800 Lin. Ft.	7,200 Lin. Ft.	9,600 Lin. Ft.
Main[e] Roadway Exit Volumes	Daily	15,000 Veh./Day	22,500 Veh./Day	30,000 Veh./Day
	Peak-Hour	1,500 Veh./Hr.	2,250 Veh./Hr.	3,000 Veh./Hr.
Public[e] Parking Garage	Daily	10,000 Cars	15,000 Cars	20,000 Cars
	Peak-Hour	3,700 Spaces	5,550 Spaces	7,400 Spaces
Transit[e] Needs	Daily	6,000 Passengers	9,000 Passengers	12,000 Passengers
	Peak-Hour	1,000 Passengers	1,500 Passengers	2,000 Passengers

(a) 12,000,000 Annual = 35,000/Day = 2,000 Peak-hour in one direction.
(b) 18,000,000 Annual = 53,000/Day = 3,000 Peak-hour in one direction.
(c) 24,000,000 Annual = 70,000/Day = 4,000 Peak-hour in one direction.
(d) Lineal feet of curb space required at all levels, all terminals.
(e) Includes only the trips related to air passengers; does not include employees or other trip purposes, and should not be used for design purposes.

Effects of Air Cargo Growth

At present, air cargo is passing through San Francisco International Airport at the rate of more than 2.5 million pounds per weekday (see Table 4), or 500 million pounds per year, and is predicted to increase 20 percent to 25 percent per year.

The volume of outbound cargo is now running about 20 percent higher than the inbound volume, probably due in part to the shipment of material to Southeast Asia in connection with the Viet Nam war.

In order to handle this cargo, about 550 commercial trucks plus 60 to 70 air mail trucks (see Tables 21 through 25) enter and leave the airport each day. The majority of these trucks are two-axle dual wheel trucks, or two-axle vans, but about 15 percent are three-axle or truck-trailer combinations.

In addition to air cargo trucks entering and leaving, about 550 entirely internal truck trips take place each day within the airport itselt to serve cargo transfer and aircraft supply functions. Many of these trips are in connection with air freight forwarder's operations. Also, another 500 trucks both enter and leave the airport on a weekday to serve the hotels, restaurants, retail shops, offices, in-flight food services, and aircraft fuel storage supplies.

The present and probable future ratios of air cargo volumes to related truck trips is summarized as follows:

	PEAK DAILY AIR CARGO VOLUMES	INTERNAL TRUCK TRIPS		EXTERNAL TRUCK TRIPS	
		AIR CARGO ALONE	ALL PURPOSES	AIR CARGO ALONE	ALL PURPOSES
1967	2.5 million lbs.	1,740	2,740	1,240	2,240
1971 (?)	5.0 million lbs.	3,500	5,500	2,500	4,500
1975 (?)	8.0 million lbs.	5,500	8,500	4,000	7,000

A truck entering the airport and later leaving represents two truck trips.

One of the things that might change the truck ratios shown previously is increased containerization, with larger and fewer trucks resulting. Another factor might be more handling of air cargo storage, sorting and grouping (containerization) at air cargo warehousing outside the airport, with trucks entering and leaving only to serve the aircraft directly, thus eliminating some of the present internal trips.

A related factor is the location of air cargo facilities within the airport. At present, most of the trucks enter and leave via the main entrance and exit roadways, and get involved in left-turns to and from that busy dual artery, generally affecting the flow of traffic upon it adversely. As the new north terminal is constrcuted, and the air cargo facilities are phased out to locations at the more northerly end of the airport, more trucks will use the San Bruno Avenue interchange, and later, the Route 186 freeway approach.

Future Vehicular Volumes

Combining the impact of increased employment, increased air passenger traffic and increased air cargo volumes, the future vehicular volumes can be estimated as shown in Table 27. However, it should be emphasized that each of these segments of airport activity may not increase at the predicted rate, and if changes occur from year to year, each segment should be examined separately, and new summations made. The aviation industry's growth has been underestimated so regularly in the past, that this possibility should not be discounted.

Table 27
FUTURE VEHICULAR VOLUMES
San Francisco International Airport Traffic Study

YEAR		1967	1971	1975
Anticipated Air Passengers		12,000,000	18,000,000	24,000,000
Total Airport Exit Volumes	Daily	42,000	65,000	80,000
	Peak-Hour	6,000	9,000	11,500
Total Airport Parking Needs	Peak-Hour	12,000 spaces	19,500 spaces	25,000 spaces

The split of these volumes among the airport interchanges will change as improvements are completed by the California Division of Highways, and as changes are made in the airport locations of employment and the internal road system. For design purposes, however, it is recommended that the peak hour design flows be taken as follows:

EXIT VOLUMES	MAIN EXIT ROAD	MILLBRAE AVENUE	SAN BRUNO AVENUE	RTE. 186 FREEWAY	NO. AIRPORT BOULEVARD
1967 Existing	2,500	500	2,200	-	800
1971	4,000	1,000	2,000	2,000	1,000
1975	4,000	1,000	2,000	4,000	1,000

As previously discussed, the arrival of Boeing 747's in 1969 could greatly increase the peak-hour vehicular demands. As a practical matter, however, the capacity of the airport interchanges will not permit those kind of peaks, and the flow will necessarily be distributed over longer peak periods.

The present survey showed that the destination of outbound airport trips does not affect the choice of airport exit nearly so much as the travel time between the airport parking lot and the freeway, or other route. This fact will lead to distribution of peak-hour traffic among the interchanges to equalize travel time, as pressure of higher volumes builds up.

The internal road system will also reflect this distribution. The anticipated traffic loadings upon the airport roads, if design proceeds as recommended in Chapter VI, is summarized as follows:

AIRPORT ROAD NO.	NAME	AVERAGE DAILY TRAFFIC 1967	1971[a]	1975[b]
R-1N	Main Exit Road	23,500	35,000	45,000
R-1S	Main Entrance Road	24,000	35,000	45,000
R-2	Airport Frontage Road No. of Millbrae Avenue	4,500	6,500	8,000
R-3	Airport Frontage Road So. of San Bruno Avenue	4,500	12,500	17,000
R-16	Service Road parallel to and So. of R-1S	500	2,500	4,000
R-18	Service Road parallel to and No. of R-1N	1,000	3,500	4,500
-	North Access Road	2,000	4,000	10,000

(a) Projected 18,000,000 annual passenger level.
(b) Projected 24,000,000 annual passenger level.

These projections are also based upon new airport construction of buildings and parking lots proceeding along the general forms shown in the Airport Master Plan.

It is important to point out in this chapter on future projections, that the ultimate restrictions in capacity and travel time for vehicular flow may not be within the airport itself at all, but in the operation of interchanges, freeways and local streets external to the airport. The airport traffic must compete for use of these facilities with the hundreds of thousands of other motorists on San Francisco Peninsula, and predicting the airport-generated usage will not adequately define the problem. However, the data compiled herein, when joined with the broader scale studies now being done by the District IV Planning Office of the California Division of Highways, the West Bay Rapid Transit District, the County of San Mateo and the Bay Area Transportation Study Commission should serve to define the highway needs external to the airport in much greater detail and accuracy than ever before possible.

In the meantime, some trends are clear, and should be considered. At the present time the three primary arteries offering external access to the airport — Bayshore Freeway, Millbrae Avenue, and San Bruno Avenue — are all operating at absolute capacity in the peak hours every day, and as general peninsula travel demands increase, the number of hours of capacity operation is increasing. The completion of successive portions of Junipero Serra Freeway may retard this trend, but cannot hope to halt or reverse it. Additional capacity can be added to Bayshore Freeway by widening and this is planned in successive stages. Similary, improvements upon Millbrae Avenue and San Bruno Avenue, particularly at intersections and railroad grade crossings can increase capacity. The completion of San Bruno Freeway (Route 138) will be a major relief, especially to the dense employee and air cargo areas at the north end of the airport.

However, projections of airport ground travel needs beyond 1975 clearly indicate the need for another route of access, especially to serve the passenger terminal area, which is now dependent upon Bayshore Freeway almost entirely. A connection to Junipero Serra Freeway from the passenger terminal area would fill this function, and is discussed in Chapter VI.

Future Transit Needs

If the same percentage of employees and air passengers use public transportation in future years as at present, and the increases in air passenger and employee origins continue to be geographically distributed over the Bay Area in the present pattern, then the future public transportation needs may look about as follows:

	1967	1971 or 18,000,000 Air Passengers	1975 or 24,000,000 Air Passengers
Barrett Bus	3,100	4,300	6,200
Other Buses	1,600	2,100	2,500
Helicopter	500	800	1,000
Taxicab	1,800	2,700	3,600
Hotel Limousine	1,000	1,500	2,000
TOTAL	8,000	11,700	15,300 Daily Outbound Passengers

In actual fact, many things may change this picture. One of the key factors is the location of future air travel generation districts. It was suggested in Chapter IV that a study of the characteristics or parameters of the districts now attracting and generating air travel trips would be useful, and might suggest trends for the future. Now, questions remain. For example, "Will future air travel from San Francisco CBD be a greater or lesser percentage of the total than at present?" The answer would directly affect the question of future transit service to a downtown San Francisco terminal.

Similarly, it can be argued that the future percentage of airport trips served by transit could increase if a good transit service on the peninsula were available. This may be true, though the trend toward dispersal works against the possibility.

For airport planning purposes, the possibility of a special purpose downtown-to-airport fixed rail transit link should not be entirely discounted, though the problem of capitalizing the initial investment would be crucial, and looks very dubious at this time.

A more fruitful area for future planning studies might be the possibility of special bus lanes on Bayshore Freeway available for downtown-to-airport express bus use. Such express lanes could be constructed (at very great expense) for the use of other peninsula transit operations besides airport bus, and, by metering controls, might also be available for some peak hour automobile use. (Buses could not begin to fill a single lane.) Thus the cost of construction would be justified by more than airport transit needs. Studies for such special bus lanes are underway in several states under Federal grants at the present time.

Future Parking Requirements

The additional 7,000 employee parking spaces required by 1972; and the additional 4,000 public parking spaces required to serve the 24,000,000

annual passenger level are a critical planning and design control. In addition, the rental car business has increased its share of the airport ground travel total steadily over the past five years, and will no doubt continue to do so. Even at the same percentage share, however, at least an additional 1,000 spaces for rental car storage are needed in the vicinity of the airport, and half of those should be as near the terminals as possible.

Because of the increased competition for usage of all available airport space, it is recommended that Rent-a-Car storage and employee lots be increasingly transferred to the remote area west of Bayshore Freeway. It appears that in the next four years 2,000,000 square feet of the additional required parking space could be provided in this area, with still more in the following four-year period, by constructing auto and pedestrian bridges across Bayshore Freeway. It might be necessary to operate shuttle buses between this area and the major employment locations at the ends of shifts, if convenient pedestrian bridges are not available.

An additional area for employee parking might be the area between the present United Air Lines Maintenance Base and the old Coast Guard Seaplane Base, at the north end of the airport. This site has the advantages of being close to the major employment location and having the possibility of ready future access to San Bruno Freeway.

The public parking garage is now proposed for expansion to an 8,000-car capacity, but the north terminal building construction will remove almost 2,000. The garage expansion will, therefore, serve only to about 1975, or the 24,000,000 air passenger level. Beyond that time, additional conversion of the areas along the main exit-entrance roads to structures for public parking may be necessary, and possibly further transfer of present employee lots to the remote area west of Bayshore Freeway.

Terminal and Garage Requirements

As discussed in Chapters III and IV, one of the areas most dependent upon sound design to avoid critical future congestion, is the terminal area. With hotel limousines, taxicabs, private autos, buses, and valet parking all competing for the use of the curbs and roadway in front of the terminal buildings, definite limitations exist. The construction of a new north terminal building will add approximately 1,600 lineal feet of curb space (both roadway levels) to the terminal complex, but rather than adding capacity to the terminal loop roadways, will simply attract additional vehicles to congest them.

In the course of the survey work, numerous unsolicited comments were made by the hotel limousine operators, bus companies, taxicab dispatchers and drivers, and the private auto drivers about the general insufficiency of loading and unloading spaces at the terminals.

Since baggage handling is one of the primary reaons for the private automobile's presence at the terminal doorsteps, it is strongly recommended that baggage facilities be included within the garage structure for both Skycap and self-checking. While it is recognized that this will involve development of a whole new system of automated baggage-handling, including conveyors from garage to terminal building, the problems that will exist otherwise demand such a system be developed.

Similarly, short-term (less than one hour) parking should be provided within the garage at the locations most readily accessible to the terminals, to take the private autos from the curb space next to the buildings.

If successful, the placing of short-term parking and baggage-handling facilities within the garage will leave more curb space available for public transportation vehicles, and reduce the congestion on the loop roadways. However, it will also mean additional traffic in and out of the garage

structure, and may require additional gates for entrance and definitely will require additional out-bound cashier booths.

At present, less than 800 vehicles per hour can be accommodated through the four existing cashier gates from the garage. To handle the volume that would exist in the peak hour in 1975, (given a successful transfer of some private autos to the garage from the terminal loop roadways), at least two additional gates would be required for each additional increment of 1,000 garage spaces. An 8,000 space garage would need at least 16 cashier gates in operation in the peak hour.

Chapter VI
RECOMMENDATIONS

External Access System

Figure 15 shows the recommended system of highway improvements needed for good external access to San Francisco International Airport.

Without these improvements, the airport will be smothered in traffic congestion for the entire foreseeable future, and even with a part of them will face difficult periods of congestion at least several times a month.

The recommended system is intended to handle the peak daily periods of airport traffic flow without serious congestion or interference from or with other than airport traffic.

The proposed Hillside-Randolph Expressway and Canal Street Expressway are both on the General Plans of the County of San Mateo and the City of South San Francisco, and were called for as medium priority construction in the 1962 City-County Highway Plan for San Mateo County. They are intended to serve the rapidly developing industrial and hotel-motel-restaurant area east of Bayshore Freeway. The two major industrial parks in that area now each employ more than 2,000 workers, and anticipate a rise to 8,000 each in the next ten years. These employees presently compete with airport traffic for the use of San Bruno Avenue and the San Bruno Avenue and Airport Boulevard interchanges. These expressways would provide significant relief to the peak hour demands of the United Air Lines Maintenance Base. It is recommended that the Airport Boulevard interchange be revised to a full service interchange as part of the Canal Street Expressway work, to be of most value to the airport. However, the City of South San Francisco is supporting the Hillside-Randolph Expressway and an interchange at that location as higher priority.

INTERCHANGES TO BE CONSTRUCTED, EXPANDED OR REVISED

NORTH

15

0

SCALE IN MILES

Wilbur Smith & Associates

RECOMMENDED EXTERNAL ACCESS TO AIRPORT

SAN FRANCISCO INTERNATIONAL AIRPORT TRAFFIC STUDY

The Westborough Expressway, connecting with the Hillside-Randolph Expressway via Chestnut Avenue, is now under construction by the County of San Mateo. When completed, and brought into the partially completed interchange with Junipero Serra Freeway, it will provide an important connection to the Colma-Daly City-Pacifica area, which has a large number of airport employees, as well as to San Francisco and Marin County, via Junipero Serra Freeway.

The proposed San Bruno Freeway, or State Route 186, is now in the final design stage by the California Division of Highways, and is scheduled for first-stage construction by 1971 or 1972. The first stage calls for four of the ultimate eight lanes to be constructed from Junipero Serra Freeway to Bayshore Freeway with interchanges at Junipero Serra Freeway and El Camino Real, and with an extension to a grade intersection at Airport Boulevard. The first stage Bayshore Freeway interchange will include connections for east-bound to north- and south-bound movements, north- and south-bound to west-bound movements, and a west-bound to north-bound on-ramp to Bayshore Freeway.

This first stage of Route 186 will relieve airport traffic in two ways: First, it will take a great deal of traffic from San Bruno Avenue, thereby making the San Bruno Avenue-Bayshore Freeway interchange available for more use by airport employees and air cargo trucks. Second, it will provide airport users with a more direct connection to Junipero Serra Freeway and the Pacifica-Daly City-San Francisco area than any other presently available, and do so without the delays of grade intersections.

The second stage of Route 186 will involve an additional four lanes (to make it four lanes each direction) and the completion of all Bayshore Freeway interchange direct freeway-to-freeway connections except southbound to eastbound and westbound to northbound. It will also include a relocation of the main lanes of Bayshore Freeway for a short distance,

and an interchange relocation and structure widening for the San Bruno Avenue interchange. There is no time schedule for this stage at the present time.

The third stage might be the eastward extension of Route 186 Freeway to meet the proposed future Bayfront Freeway, and perhaps some additional direct connections to Bayshore Freeway.

It is recommended that agreement on the design details of Route 186 Freeway be pursued as a top priority item for careful study by the Airport Planning office, because of the far-reaching nature of this facility's effects, and the urgent need for its completion to meet traffic demands.

The proposed future Bayfront Freeway is an adopted State Highway Route with no specified location except "Between the Bay and Bayshore Freeway." There is considerable opposition to it by conservation and planning groups, on the grounds that the bay fill it involves will affect the natural ecology of the region, and will encourage further encroachment upon baylands.

It is recommended that San Francisco await the outcome of current regional transportation needs studies before taking any action that might preclude the possibility of Bayfront Freeway becoming a reality. It appears that the airport will require addititional access capacity by 1980 or sooner of a magnitude that could only be met by such a facility.

It is recommended that the Main Airport Entrance Road interchange with Bayshore Freeway have its structures and ramps each widened to two lanes at the earliest possible time to increase access and exit capacity at that key point.

A more long-range project to serve the passenger terminal area is the proposed Airport-Skyline Parkway, connecting the main airport entrance roadways with Junipero Serra Freeway, via the Bayshore Freeway interchange. 69

and an interchange with the proposed "Millbrae Spur" extension of Junipero Serra Freeway.

Without this connection, or one of comparable capacity to distribute airport traffic to facilities other than Bayshore Freeway, the airport will remain dependent upon Bayshore Freeway, and will not be able to provide access capacity from the terminal sufficient for the 1975 demand, with the freeway traffic being the control.

Such a connection would also have value to Millbrae and the region in general. A comparable facility was proposed in 1962 in the City-County Highway Plan for San Mateo County.

The Millbrae Avenue interchange with Bayshore Freeway also needs reconstruction, preferably in connection with grade separations at Millbrae Avenue and Rollins Road and the Southern Pacific railroad tracks. This interchange does not now serve the airport well because of the interchange inadequacies and the peak-hour competition from Burlingame's Airport Industrial Park, which employs several thousands of persons.

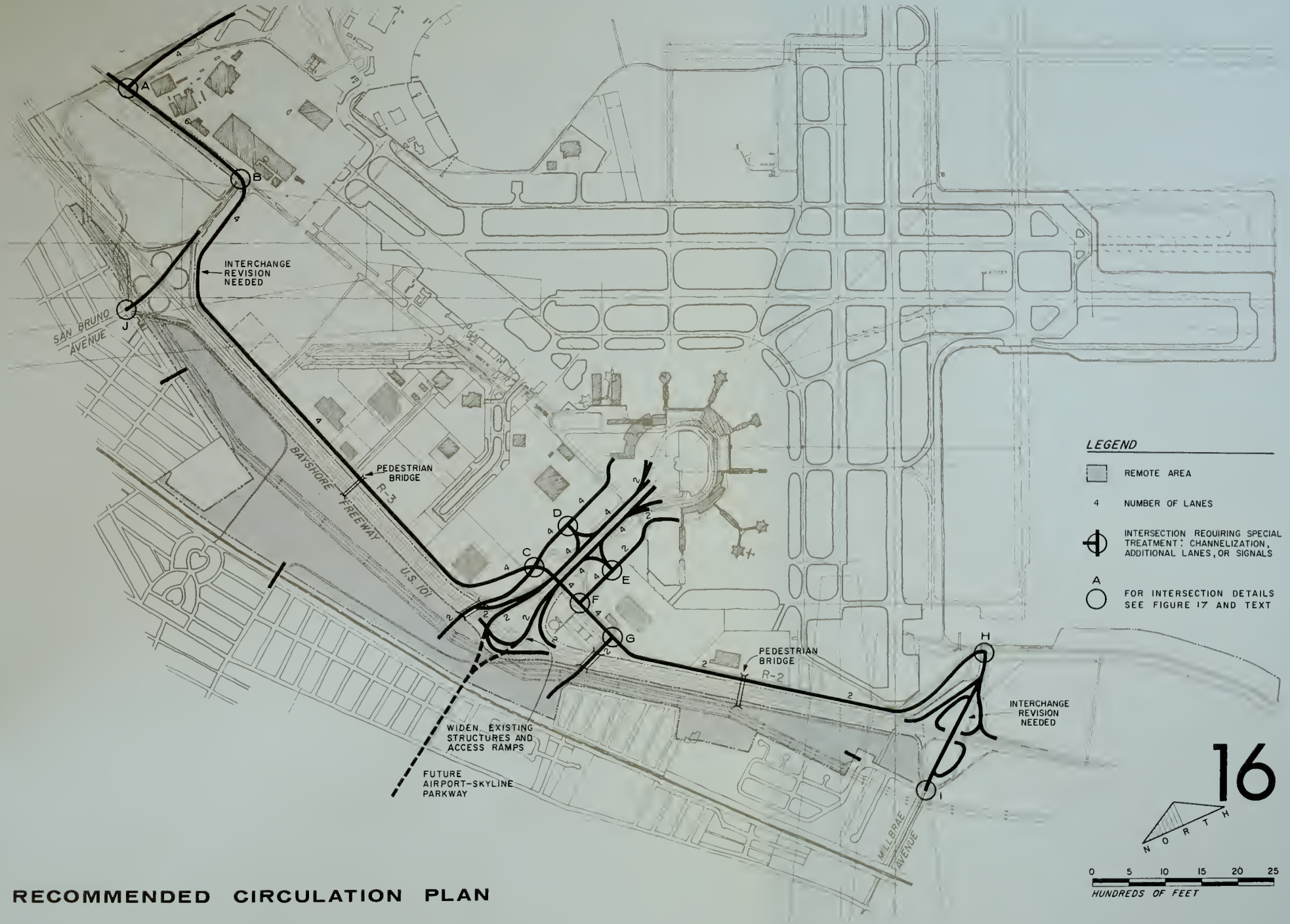
Internal Circulation System

Recommended improvements to the internal circulation system are shown on Figure 16. In order to prepare for the needs of the next few years, it is recommended that these improvements be undertaken by the Airport or by the jurisdictions serving and adjacent:

1. Expand the ramp connections between Bayshore Freeway and the main airport terminal roadways to two lanes each. This will require adding several feet of width to the two overcrossing structures, as well as to the northbound surface ramps, together with work on the freeway lanes.

RECOMMENDE

SAN FR



16

RECOMMENDED CIRCULATION PLAN

It is essential to the orderly flow of airport traffic that this be undertaken within the next four years.

2. Expand airport road numbers R-1N and R-1S (main entrance and exit roads) to four lanes each, from Bayshore Freeway to the Terminal, and eliminate all surface connections to these roads except at the two points shown on Figure 16. These two points should be acceleration-deceleration lane type connections, as shown. No crossing of these two roadways at grade can be tolerated.

   Two lanes of the four inbound should serve the garage, and two diverge to the terminals. The second divergence point, to the upper and lower levels of the terminals, should be far enough away from the first to allow driver decision-time. Outbound treatment should be similar. Signing treatment is of the greatest importance and should be designed by professionals with experience in traffic signing.

   Connections to the garage from the upper level should be provided beyond each terminal entrance, to allow autos to drop passengers and then proceed directly into the garage without circling on the main roadways. Similarly, a means of returning from the garage to the lower terminal levels without getting on the main exit road is needed. (Baggage-handling facilities within the garage should partly obviate these needs.)

3. Separate Airport Boulevard frontage road (R-2 and R-3) from the main entrance-exit roads. Capacity analyses of the existing intersection show this to be a critical need. Separation could be done either by taking the frontage road over or under, but grade and head room requirements are critical either way.

4. Widen R-3 (Airport Frontage Road between Main entrance and San Bruno Avenue)to four lanes, with provision for left-turn lanes at important intersections (including major parking lot entrances).
5. Relocate roads R-16 and R-18 (service roads parallel to Main Entrance Road) to the locations shown on Figure 16, and widen them as shown.
6. Construct pedestrian and auto bridges to serve the area west of Bayshore Freeway, and to provide additional points of access to the airport and to employee lots.
7. Add to the Millbrae Avenue interchange with Bayshore Freeway and improve the Millbrae Avenue traffic flow west of Bayshore Freeway, by improvement of the Millbrae Avenue-Rollins Road intersection.
8. Improve the traffic flow on San Bruno Avenue by widening at the point of junction with the Bayshore Freeway south to west-bound off-ramp, as shown on Figure 16.
9. Channelize and signalize the intersections of Airport Boulevard with San Bruno Avenue and the west parking lot of United Air Lines Maintenance Base.

It is strongly recommended that as design proceeds on the internal road system, engineers familiar with traffic design be utilized to insure that the details of design which affect capacity and efficiency are included. The present airport roadways could have operated much more efficiently in recent years if some important details had not been overlooked, such as truck and bus turning-radius requirements, proper lane and island channelization treatment, parking lot layouts and entrance-exit design, and signalization methods.

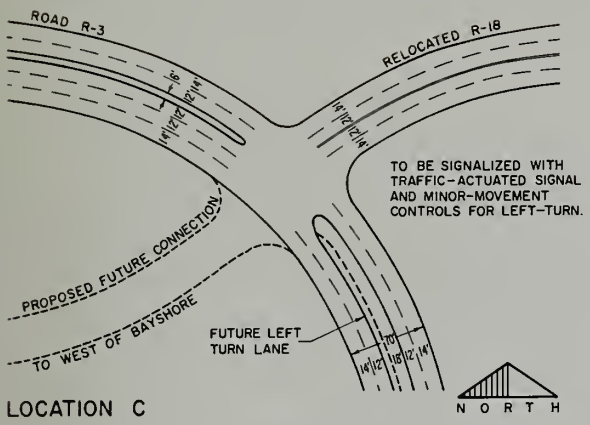
Schematic drawings showing details of the designs recommended at six of the intersections (intersections C,D,E,F,G, and H on Figure 16) are shown on Figure 17. The designs at intersections A,B,J, and I are not shown, as those intersections are not under airport jurisdiction. However, the airport can support and foster good design treatment at those locations also, by working in coordination with the County of San Mateo and the Cities of South San Francisco, San Bruno and Millbrae.

To be efficient, the airport road system need not be unpleasant, and in fact, careful design as recommended above also makes possible more aesthetically pleasing design. One area of great importance in this respect is the main entrance road approach to the terminal buildings, and the signing included with it.

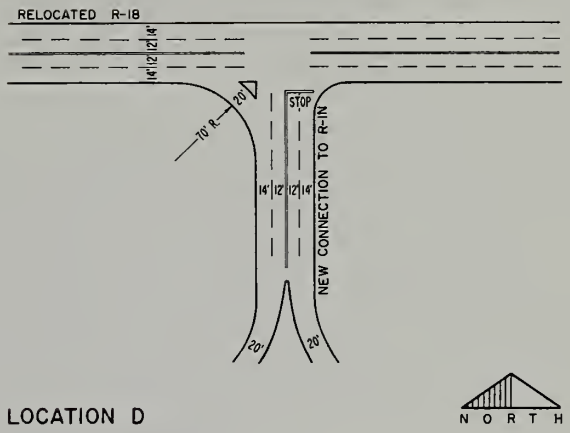
Parking Design

The design of parking lots and garages should also be undertaken by engineers and architects experienced in traffic flow characteristics. Employee parking lot entrances, for example, are fully as important as other major intersections and should be so treated, as in details E and F of Figure 17. Sufficient points of access to parking lots and structures must be provided to prevent long queues and the resulting congestion both in and out of the parking lots.

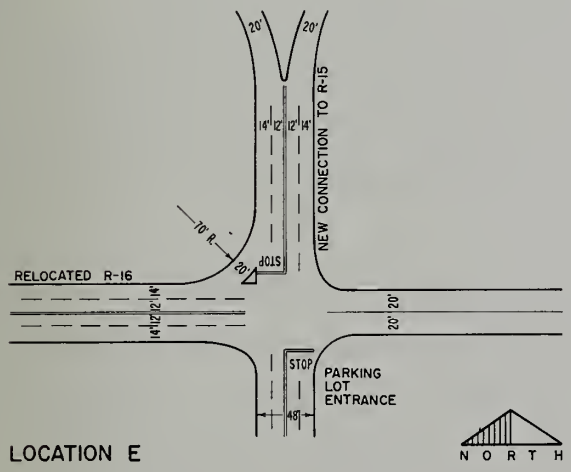
Parking lots in the remote area west of Bayshore Freeway need careful location to insure accessibility by pedestrians and vehicles to the remainder of the airport, via structures, and also to permit good access from west of Bayshore Freeway. Figure 16 shows suggested access points from Aviador Street, San Felipe Street, and Angus Avenue. The selection of access locations must be coordinated with the Cities of Millbrae and San Bruno to avoid resentment of the residential neighbors.



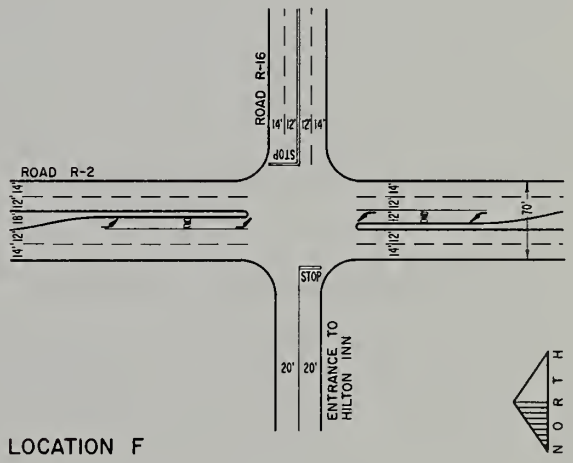
LOCATION C



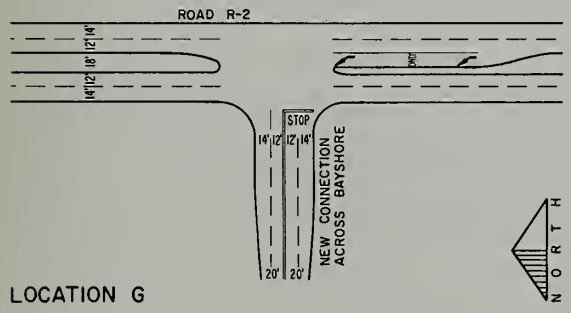
LOCATION D



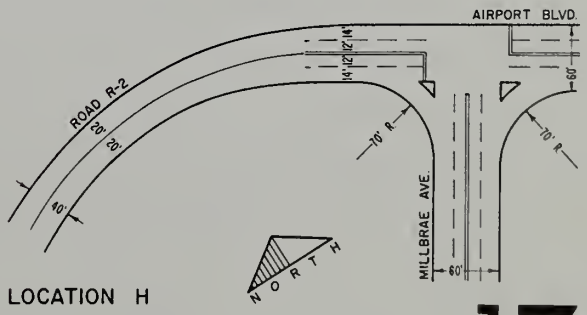
LOCATION E



LOCATION F



LOCATION G



LOCATION H

17

0 50 100 150 200 250 300
SCALE IN FEET

RECOMMENDED INTERSECTION DETAILS

Wilbur Smith & Associates

SAN FRANCISCO INTERNATIONAL AIRPORT TRAFFIC STUDY

It is recommended that approximately 2,000,000 square feet of the remote area be set aside for parking, with construction in stages.

Terminal Access Design

It is recommended that the design of curb loading spaces and roadway widths in front of the new north terminal building be done to permit traffic to flow freely even when buses and cars are stopping haphazardly for loading passengers. The width of the parking lane should be considered as ten feet minimum, and the through lanes as twelve feet minimum, with an additional two feet of clearance to curbs or medians.

If the new garage structure includes convenient, short-term parking and baggage-handling facilities, as suggested in Chapter V, the roadways in front of the terminal should be evaluated to see if metered parking spaces cannot be replaced by further taxicab, bus and limousine loading areas.

Points of merging and diverging in the loop roads circling in front of the terminals need standard highway design, striping and signing treatment to make positive directions for the frequent unfamiliar driver, and eliminating confusion and congestion.

It is essential that the airport management carefully investigate the time schedules of all Boeing 747 flights to make sure that adequate capacity of the terminal facilities will exist in the peak hours. As pointed out in Chapter IV, it would not take too many 747 flights in the same hour to completely swamp the garage, the curb loading spaces, and the airport roadways.

The Long-Range Look

Most of the projections and recommendations contained in this report are for the next eight years, more or less, and are predicated upon a maximum air passenger level of 24 million annually. Airport tenants were

reluctant to discuss employment or building plans for a period beyond the next four years, partially because of their uncertainty about the shape of the future in aviation.

But what about 12 or 20 years from now? Will the recommendations made herein have any application to the long-range needs? While crystal-ball gazers are a notoriously fallible group, it is important to attempt to understand all we can about the future.

Here, then, are some trends to consider:

1. Greater dispersal of residences, offices and commercial centers. This trend makes transit, which thrives on concentrations of people, ever more difficult.
2. Increasing dependence upon the automobile for trip purposes where mobility and flexibility are important. This is apparently true of air travel-associated trips, and will probably continue.
3. Greater speeds of travel, both in the air and on the ground, and increasing emphasis upon the value of time. People are willing to pay more for fast service and quick travel, and are more impatient of delays.
4. Rapid strides in travel technology. This includes both the personal vehicle and transit systems. Major changes in each may evolve in the next 20 years, though probably after careful step-by-step testing.

To all appearances, the dominance of the private vehicle as a travel mode for airport trips will continue and perhaps intensify, and

thus improvements in handling the automobile are imperative. Such improvements may include metering and later, completely automatic control of the flow of cars upon highways. This is entirely conceivable for the routes serving San Francisco International Airport, and would afford significant increases in their capacity without new right-of-way acquisition.

As parking problems grow, "people-movers" of various sorts may come into ever greater use to transport people from remote parking lots to the terminal or employment centers. This trend is already much in evidence.

In the meantime, the growth in air travel will mean an absolute increase (though probably not a percentage increase) in the numbers of airport trips that can be served by transit, and more efficient transit systems will eventually come into use. Buses may use express lanes on freeways and special purpose fixed-rail systems certainly cannot be ruled out as a future possibility. Better water transportation on the Bay by hydrofoil or air-supported craft may supplement the helicopter, as demonstrated in the research project by the Port of Oakland two years ago.

Computer systems may make it possible for an entire trip to be programmed in the future, by simply making an airline reservation. The trips to and from the airport may be scheduled in advance, just as the flight now is, eliminating much of the waiting and confusion at the terminal. The transit system would know, at least hours in advance, exactly how many passengers for what destinations to expect, and could program accordingly.

It is clear that new ideas will come into play more and more, and that the challenge to adapt will be great. In order to be aware of changes in travel patterns, it is recommended that periodic sampling of travel data, and more intensive study of travel characteristics be undertaken by the airport. The challenge is great, but can certainly be met.

APPENDIX

Table A-1
TABLE OF EQUIVALENTS
O-D ZONES TO CENSUS TRACTS
IN SAN FRANCISCO, SAN MATEO
AND SANTA CLARA COUNTIES
San Francisco International Airport Traffic Study

DEST. ZONE	COUNTY	CENSUS TRACT NUMBERS (INCLUSIVE)
01	San Francisco[a]	A-10 through A-23; K-01 Through K-04; K-06; J-01; J-09; J-11; J-17; N-01
02	San Francisco[a]	A-01 through A-09; B-01 through B-10; J-02 through J-08; J-10; J-12 through J-16; J-18 through J-20; N-02 through N-15
03	San Francisco[a]	L-01 through L-05; M-01 through M-11
04	San Francisco[a]	C-01; D-01 through D-02; E-01 through E-03; G-01 through G-04; H-01 through H-03
05	San Francisco[a]	Ø-01 through Ø-08; P-01 through P-03; Q-01; R-01
06	San Mateo[b]	10 through 19
07	San Mateo[b]	01 through 02
08	San Mateo[b]	03 through 09
09	San Mateo[b]	23 through 28
10	San Mateo[b]	20 through 22
11	San Mateo[b]	97
12	San Mateo[b]	29 through 32
13	San Mateo[b]	33 through 38
14	San Mateo[b]	39 through 40
15	San Mateo[b]	41 through 51; 55 through 57
16	San Mateo[b]	52 through 54; 60; 65
17	San Mateo[b]	98
18	San Mateo[b]	58 through 59; 61 through 64
19	San Mateo[b]	76; 83 through 86
20	San Mateo[b]	66 through 75; 77 through 82; 87 through 93
21	San Mateo[b]	94 through 96
22	San Mateo[b]	99
23	Santa Clara[c]	046 through 048; 086 through 093; 108-114
24	Santa Clara[c]	094 through 107; 115 through 117
25	Santa Clara[c]	062 through 085
26	Santa Clara[c]	049 through 061
27	Santa Clara[c]	001 through 032
28	Santa Clara[c]	033 through 045
29	Santa Clara[c]	118 through 127

(a) Source: Census Tract Street Index, City and County of San Francisco; March, 1963; San Francisco Department of City Planning.
(b) Source: Census Tract Street Index, San Mateo County, as modified by West Bay Rapid Transit District, 1966.
(c) Source: Census Tract Street Index, Santa Clara County, 1966 Edition, County of Santa Clara Planning Department.

Table A-2
SURVEY STATIONS
San Francisco International Airport Traffic Study

AUTO-TRUCK

STATION NO.	NO. OUTBOUND LANES	LOCATION
1	3	Main Exit Road Just west of Airport Frontage Road
2	1	Airport Frontage Road Just north of Millbrae Avenue
3	1	Airport Frontage Road Just west of Airport Boulevard
4	1	North Access Road East of Airport Boulevard
(5)	(United Maintenance Base Employee Questionnaire)	(San Bruno Avenue and Airport Boulevard)

PUBLIC TRANSPORTATION

SFO Helicopter	-	Passenger questionnaires distributed by flight crew and collected at trip-end
Barrett Bus Hotel Limousine Yellow Taxicab	- - -	Passenger questionnaires distributed by driver and collected at trip-end
Greyhound Bus	-	Passengers interviewed at bus-stop before boarding

Table A-3
OUTBOUND VEHICLES WEDNESDAY, JULY 19, 1967[a]
San Francisco International Airport Traffic Study

HOUR	R-1N AUTOS	R-1N TRUCKS	R-1N BUSES	R-1N TAXIS	R-2 AUTOS	R-2 TRUCKS	R-3 AUTOS	R-3 BUSES	R-3 TRUCKS	NC. ACCESS ROAD AUTOS	NC. ACCESS ROAD TRUCKS	TOTAL OUTBOUND VEHICLES
10-11 P.M.	1,121	12	8	29	59	1	75	2	1	10	0	1,318
11-12 Mid.	1,050	11	6	23	99	1	85	1	1	20	0	1,297
12-1 A.M.	810	8	4	18	99	1	35	2	0	25	0	1,002
1-2	371	4	4	11	30	0	20	1	0	5	0	446
2-3	235	3	4	8	20	0	25	1	0	5	0	301
3-4	179	2	4	5	15	0	5	0	0	5	0	215
4-5	101	1	6	12	10	0	5	1	0	5	0	141
5-6	107	1	6	16	10	0	20	1	0	5	0	166
6-7	345	8	8	19	5	0	150	4	3	5	0	547
7-8	782	16	15	27	98	2	250	6	5	29	1	1,231
8-9	1,101	74	16	33	96	4	200	6	5	29	1	1,565
9-10	842	88	10	34	58	2	90	3	6	25	0	1,158
10-11 A.M.	903	57	8	38	77	3	80	3	7	39	1	1,216
11-12 Noon	997	92	14	32	77	3	75	3	7	20	0	1,320
12-1 P.M.	991	52	12	37	106	4	150	3	9	64	1	1,429
1-2	1,081	42	8	41	58	2	100	3	8	20	0	1,363
2-3	1,291	59	13	52	192	8	275	3	11	25	0	1,929
3-4	1,682	58	15	60	339	11	100	3	16	98	2	2,384
4-5	1,887	40	15	68	220	5	100	4	12	98	2	2,451
5-6	1,148	25	12	65	343	7	40	5	8	20	0	1,673
6-7	1,052	23	14	61	83	2	25	3	5	35	0	1,303
7-8	1,113	24	16	57	29	1	50	2	5	15	0	1,312
8-9	1,273	27	10	60	49	1	35	2	5	5	0	1,467
9-10 P.M.	1,007	22	8	43	40	0	20	3	4	5	0	1,152
TOTAL	21,469	749	236	849	2,212	58	2,010	65	118	612	8	28,386

(a) San Bruno Avenue not included.

Table A-4
SURVEY RESPONSE SUMMARY
San Francisco International Airport Traffic Study

WEDNESDAY	SURVEY CARDS DISTRIB.	SURVEY CARDS RET'D.	CORRECTED TOTAL COUNT OF GROUP	% RETURN OF CARDS DISTRIB.	% RETURN OF TOTAL GROUP
Auto	21,798	13,313	33,685 autos[a]	61.1	39.5
Truck	961	341	1,190 trucks	35.5	28.7
Commuter Club Bus	844	830	844 pass.	98.3	98.3
Barrett	3,000	1,684	3,043 pass.	56.1	55.3
Greyhound	587[b]	587	760 pass.	100.0	77.2
SFO Helicopter	450	84	456 pass.	18.7	18.4
Yellow Cab	500	83	1,868 pass.	16.6	4.4
Hotel Limo.	500	0	1,060 pass.	0.0	0.0
SUNDAY					
Auto	16,229	5,742	23,106 autos[a]	35.4	24.9
Truck	206	62	260 trucks	30.1	23.9
Commuter Club Bus	0	0	0	0.0	0.0
Barrett	3,000	1,562	3,220 pass.	52.1	48.5
Greyhound	0	0	550 pass.	0.0	0.0
SFO Helicopter	400	120	431 pass.	30.0	27.8
Yellow Cab	500	87	1,975 pass.	17.4	4.4
Hotel Limo.	500	23	1,050 pass.	4.6	2.2

(a) Total does not include buses, trucks, taxis, limousines, but includes employee questionnaires.
(b) Interviews.


WILBUR SMITH